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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

DEATH OF MR. JAMES W. SMITH.—We chronicle with great regret the death of Mr. James W. Smith, ex-President of the Consolidated Gas Company, of New York, which sad happening occurred very suddenly on the evening of November 27th. Although Mr. Smith declined, at the last election in the Consolidated Company, to continue in the office of President, he nevertheless was, at the time of his decease, a controlling factor in the management of its affairs. Before the partial consolidation of the gas interests of this city was accomplished, Mr. Smith had for years been prominent in the direction of the affairs of the Manhattan Gas Light Company, and for more than a quarter of a century he was concerned influentially in the gas business of the State. He was in his 61st year, and had the full confidence, respect and affection of his business associates, contemporaries and friends. The funeral services were held at his town residence, 467 Bedford avenue, Brooklyn, on the evening of Friday last.

THE LATEST FROM BROOKLYN.—The newest and queerest move in the Brooklyn gas situation was announced on the 28th November, when official promulgation was made that on and after December 1st the gas rate in that city would be $1.25 per 1,000, instead of the 90 cent net rate which has prevailed there for some months. This "unanimity of price" affords the strongest (and the first tangible) proof that the men whose personal differences precipitated the Brooklyn war of rates have agreed to again work in harmony, and that either consolidation or districting has been arranged for. Whether so or not, the puerile business methods pursued by the men in charge of the majority of the Brooklyn Gas Companies (the Nassau Company is not one of that majority, as we count the latter), may be said to have earned for them the right to be considered as lineal descendants of the children of the abbey, whose virtue was so transparent as to cause ordinary observers to fear that their virtue was vice. Indeed, the discontent aroused amongst the holders of small lots of stock in the various Companies, because of the management of the same by some of the reputed holders of large blocks of stock, looks to be sufficiently strong to cause them to unite in common for an appeal to the courts for the purpose of determining whether the moneys expended in the past year or so for the duplication of mains, etc., were expended honestly or not. Certainly, the expenditures were decidedly unnecessary. The comical side of the case is shown in the assurance with which the Brooklyn "managers" announce a restoration of the $1.25 rate, they evidently believing that, having mastered the situation, in so far as their personal squabbles are concerned, the future is assured. Perhaps so; and we hope so—for gas of the quality sold in the cities of New York and Brooklyn is cheap at $1.25 per 1,000—but "reform" is in the air, and a reform Legislature, in which "reformers" are absolutely crowding each other for room, will likely—almost certainly—see to it next year that the legal rate in the State, "in cities of the first class," will be adjusted at $1 per 1,000. When the "bills are on" it may be hard for the Brooklyn gas manufacturers to convince many of the interior legislators that $1 per 1,000 is an abnormally low rate when the books of the Companies concerned will show that a fair profit was made when gas was being sold at 90 cents per 1,000. Were it not for its effect on the business of the New York Companies, whose proprietors were never in such an advanced paretic stage as to imperil their properties for the sake of revenging personal differences, we would not attempt to hinder for a moment the passage of such a bill.

NOTES.—Under the clever management of Mr. J. C. Ross, Secretary and Superintendent of the Perth Amboy (N. J.) Gas Light Company, the concern is gaining ground rapidly. On the 1st inst. the Company announced a reduction in the selling rate to $1.90 per 1,000 cubic feet; and the works have been put in good condition. During the past two months a considerable addition to the main system was completed, and the retort house has been equipped with a set of the Flemming regener-

ative benches. In advising us of the situation at Perth Amboy, Mr. Ross says: "Consumers are being taken on with gratifying frequency, and gas is superseding incandescent electric lighting in many instances. We are adjusting quite a large number of Welsbach lamps, and we expect to make a number of improvements in the spring. Next year we will push the sale of gas stoves."——We are in receipt of a copy of a handsome pamphlet that is being distributed by the proprietors of the Gas Company of West Chester, Pa., among the residents of that go-ahead center of Delaware County. The pamphlet has the title, "Answers to Gaseous Questions," and is clearly indicative of its contents, for it contains replies to many questions that are usually asked by consumers of gas—irate and otherwise. It is nicely illustrated, and a goodly portion of its explanatory matter is devoted to an exposition of the merits of gas for heating and cooking.——Secretary and Treasurer Selb, of the Ironton (O.) Gas Company, has also been devoting himself to the compiling of matter that will tend to educate the gas consumers of that city to know how to use gas for lighting in an intelligent manner. The result is an attractive 4-page folder that is replete with useful hints.——We were in error last week in stating that the late Mr. Thomas D. Gilbert, of Grand Rapids, was born in Braintree, Mass. His birthplace was Greenfield, Mass., and the date of his birth was December 13, 1815.

"An Interesting Application of Equilibrium," and How It Was Done.

By an "Old Contributor."

About five years ago, when the author was in charge of a large gas works in the West, it became desirable to make a 12-inch connection to a 20-inch main located between the exhauster and retort house. We did not like to waste time and money by "missing" long enough to make the change; so this is how we did it. A suitable saddle-piece was procured and placed where it was to go, and the desired opening and both holes of said saddle-piece were marked off on the main, using the same as a template. A series of ⅛-inch holes were then drilled, about 1 inch between centers, all around the outline of the desired opening, as marked, and the boltholes were drilled and tapped. As each hole was drilled a soft pine plug was driven into it as a temporary stopper. An eye-bolt was screwed into the center of the piece which it was intended to remove. When all was ready—the saddle-piece having been previously fitted with a millboard gasket, the tap bolts grommeted and leaded, and a valve securely bolted to one end of the saddle-piece—the exhauster engineer was instructed to slow down his engine until zero was shown on his vacuum gauge, and to keep it so until the job was done. As soon as the engineer signaled that he was ready, and a U-gauge placed nearby showed the proper figure, the piece in the 20-inch main was knocked in with a sledge, all pieces removed, and the saddle-piece and valve bolted in place, and it was done. Gas was passing through the main during the whole time. The exhauster was not stopped, but all was done as just described. Some years later it became desirable to make a similar connection at another works, which the same Company had in the meantime acquired. The Superintendent of said works was informed by the author of the result of his experience with the preceding job—in fact, he was asked to inspect the place mentioned for the purpose of explaining how the change could be made—and the author was pleased to learn, at a subsequent meeting of the Western Gas Association, that the suggestion had been acted upon with the to-be-expected agreeable results. The author thought little of the matter at the time, and no more of it now; but it seems that a former assistant of his thought so well of it as to write it up for general information; wherefore the writer thought it might be of interest to the readers of the American Gas Light Journal, and hence he gives the story.

The principle of having one exhauster governor regulate the to-be-desired pressure in the hydraulic mains, when more than one engine and exhauster is required to do the work, was put in operation at the works, only with this difference—that no steam engine governor was used; and I doubt that one is now employed at the same plant. One engine was speeded to what was considered its best working point, and then left with the throttle valve set at that point. The second engine, governed by a Huntoon exhauster governor, and having previously had its flywheel greatly reduced in weight to make good action of the governor possible, then took care of the full range of variation in pressure common in the hydraulic main of a large coal gas works. These operations were original with the author at that time, although it would seem to him that common, practical sense would dictate such a course to anyone similarly placed; in fact, it may have been done elsewhere often enough, though we had not heard of it.

Notes on Coin Meters.

[A paper read by Mr. Frank Livesey, before the Southern District Association of Engineers and Managers.]

There are probably between 80,000 and 100,000 houses and tenements in South London without any gas supply. Is it desirable to secure the inhabitants of these houses as consumers; and, if so, how is it to be done? Such questions have oftentimes been asked, but it is only lately that any solution has been found; and the prepayment meter, of the penny-in-the-slot description, is the discovery. Such consumers will, however, not be obtained by adhering to the obstructive conditions so common a few years past. The would-be consumer of this class will not buy fittings and pay for fixing them, nor will he give a deposit, for the simple reason, in many cases, that he does not possess it. A quarterly account, too, is quite out of the question; and it is unreasonable to expect him to pay for fixing the tubing in his landlord's house. If the gas company or corporation are to do their own share of the work as well as the tenant's and the landlord's portion, they cannot supply gas at the same price as to the ordinary consumer.

Convenient and Cheap.—People are willing to pay for convenience, for it has its money value; and there can be no doubt that this system is a very great convenience. But, as well as being convenient, it is also as cheap as oil for lighting and cheaper than any other system for cooking. Gas cooking will not compare favorably when the management of the stove is left to an extravagant cook; but it is quite a different matter where the housekeeper is herself the cook, and checks the expenditure by noting the pennies required, week by week to cook the daily meals. The testimony of these consumers is that gas is the cheapest method of cooking, and, consequently, when it is supplied at 18 cents per 1,000 cubic feet cheaper to the ordinary consumer there can be no doubt on the subject—always supposing it to be under proper management.

The quantity of gas consumed will vary with the habits of the people supplied. In country districts it is comparatively low for lighting purposes. But taking South London as a whole, the average will be about 11,500 cubic feet per annum; and where a cooker is supplied, another 8,000 cubic feet may be added—making 19,500 cubic feet as a total. Taking the 11,500 cubic feet, as giving the least favorable return, the question must be decided what amount is required for the hire and maintenance of the meters and fittings and for extra labor in fixing. The meter can be treated as in the case of an ordinary consumer—charging 10 per cent. on the net cost.; and if this rate will pay for the meter it will more than pay for the fittings, if they are of a substantial character, for they will not require so much attention, and should last as long before being repaired.

The accommodation given by the South Metropolitan Gas Company is: One pendant; two brackets, with burners and galleries, but no glasses; and one ring burner, or, in its place, a small cooker, having two burners on the hot plate, with oven below. The cost is as follows:

The lighting portion	$2 29
The ring burner	41
Labor for the above	5 25
The meter	10 75
The service, tap and labor	3 02
	$21 72
If the cooker is substituted for the ring burner, add	6 20
	$27 92

The cost of connecting an ordinary 3-light consumer would be $9.52; so that there is an extra charge upon this class of $12.20 when the ring burner is used. Now, 11,500 cubic feet of gas at 77 cents per 1,000 cubic feet, yields a rental of $8.84. But the ordinary price of gas is 58 cents = $6.70; thus giving $2.14 per annum to pay all extra charges—that is, meter rent, rent of fittings, increased cost of collection, and attention to the meters. The $2.14 can be distributed as follows, though these are not exactly the figures adopted by the South Metropolitan Company:

Meter rent	$1 12
Fittings	87
Leaving for increased cost of collection and other charges	15
	$2 14

Whether it is correct or wise to put the whole, or only part of this expenditure to capital, must be decided by those most interested.

The question has arisen, if a cooker is supplied, whether a weekly rent should be charged. But surely this is not necessary; for by add-

ing, roughly, 30 per cent. to the cost, 70 per cent. is added to the revenue. Neither is such a plan satisfactory or convenient to the consumer.

Benefit to the Gas Company.—The extra charges on this business are met by the increased charge for gas; leaving the rental received on the same basis as that of other small consumers. There is this advantage on the side of the prepayment meter, that the expenditure needed upon mains is much less. Taking the period since the starting of the system, every ordinary consumer has required an expenditure of more than 20 times the amount on new mains that was found sufficient for these new consumers. This is easily accounted for by the many miles of mains which are laid to supply street lamps only. In one growing district of southeast London 8,180 yards of main were laid to supply 101 lamps and 171 consumers; but now the number of consumers has increased to 869—that is, 698 new services on the same mains.

In every gas undertaking there will be a certain amount of bad debts, varying in different towns. In London the percentage on the rental appears to be higher than in most provincial towns, being about 0.58 per cent., as compared with 0.25 per cent. Though there are no bad debts, in the strict meaning of the term, with a prepayment meter there will be deficiencies caused in different ways—some by incorrect working of the prepayment movement, and a few probably by fraud. In the latter case, the simplest method seems to be to give the consumer the opportunity of making good the deficiency, or it may be the damage done; and if no response is made, to at once remove the meter.

With some meters the losses have amounted to 1¼ per cent. on the rental; but it must be remembered that the first ones issued were not so accurate as those now made—nearly all the makers having altered their first design for a stronger and simpler pattern. The 1¼ per cent. includes many of these early pattern meters, and therefore it must not be considered as a permanent figure. There is, in fact, no reason to suppose that the losses on the prepayment system should be greater than the bad debts of the ordinary consumer.

For the Meter Makers.—For this purpose the prepayment mechanism should be strong; as, at times, the meter receives rough treatment. The arrangement for regulating the price should allow of alterations of one cubic foot of gas (or even, in some cases, half a cubic foot would be necessary), with facilities for making the alteration quickly, and without moving the meter. When the purchased gas is all exhausted the supply should be shut off by means of a valve, giving warning shortly before the gas is consumed. When the coins are deficient as compared with the index, either the meter is out of order or there is some fraud taking place, which in a few cases it is difficult to detect. But most of the first clumsy attempts in this direction are so clearly brought home to the consumer when the money box is opened that they have not been tried a second time; and the methods now adopted in the best meters will prevent tampering in cases where this evidence is not forthcoming. The prepayment mechanism appears to be more conveniently placed at the side than at the top of the meter; for it is at times difficult to find a good position for the meter in small houses, and it is more so if the height is increased some 4 or 5 inches.

For the financial success of this system it is very necessary to know what the average consumption will be—information which can only be gained by trial. Having found this to be satisfactory, it is only necessary to add a sufficient amount to pay the extra capital and revenue charges, and the success will be certain. It has also this recommendation—that the consumption more nearly approaches a regular winter and summer demand than in the ordinary course. It is a more satisfactory business to the manager than, for instance, gas fires, which are only required at the darkest time of the year, during the coldest weather, and when all the manufacturing apparatus is strained to the utmost.

In reference to the statement of increased cost for collection and other charges of 15 cents, I am bound to say 15 cents does not cover that increased cost of collection. We have had a little experience in collecting this amount, and we find it is rather a heavy item. It costs considerably more than the ordinary collection, but as the districts fill up we have great hope that the figures will be very much reduced; but certainly 15 cents will not pay for these other charges.

Discussion.

Mr. A. Dougall (Tunbridge Wells) said that during the present year his Company had had some considerable experience in the application of this coin meter system, and he might say that at first it was thought by some of their people that the system might do very well in manufacturing towns, but that it was not at all applicable to a residential town such as Tunbridge Wells. However, they eventually decided to give the system a trial, and they resolved to fit up houses of a rental of $100 and under per annum, laying the service free, fixing the meter, and running the supply to four different parts of the house. When suitable they also introduced a boiling ring free, and in some cases supplied a cooker, for which they charged a rental of 62 cents a year. The total cost, in their case, of doing this work amounted to something like $20. Their present price for gas to the ordinary consumer was 80 cents, and they gave 20 cubic feet for the 2 cents, which made the price $1 per 1,000 cubic feet. As they had not had the system in operation a whole year he could not give the exact figures with regard to the consumption per house, but from the figures that had been placed before him he could see that, at all events, it would exceed an average of 10,000 cubic feet per annum. That 10,000 cubic feet, at 20 cents per 1,000, gave them a profit of about 11 per cent. on their outlay. About three years ago he had occasion to prepare some figures with regard to the supply of his district, and he then found that of the 5,300 inhabited houses there were 2,975 using oil or other illuminants. He also discovered that there were consumed in the town 120,000 gallons of oil a year. These figures were quite conclusive, to his mind, that there was ample scope in their town for the introduction of such a system as Mr. Livesey had been describing; and their experience since had amply confirmed him in that opinion. Although they had only started this system at the beginning of the year they had now fitted over a thousand houses, and they had a great many more orders yet to execute; in fact, he believed that before they had finished they would reach 2,000 consumers. The people who had—the privilege, he was going to say, of being supplied in this way very highly appreciated it. They had not had a meter returned, and every one who used it spoke in glowing terms regarding it, and would not now like to be without it. They could understand this when they remembered the trouble—not to say anything of the cost—of cleaning and trimming lamps. The oil merchants and the small coal vendors were already feeling the pinch caused by the introduction of the system, and he heard only the other day that the sweeps were complaining that very soon their occupation would be gone. He was sure that this system would mark an epoch in the history of gas companies—a very important epoch—and that it would prove a source of profit to the companies, and a great boon to all who adopted it. They were all very much obliged to Mr. Livesey for bringing this subject specially before them.

Mr. Geo. Livesey said that before they went further he would like to ask Mr. Dougall on what grounds he justified the charge of 62 cents, seeing he got an extra 20 cents per 1,000 for the gas burned.

Mr. Dougall said he could only justify it on this ground, that in the one case they spent, say, $20, and in the other $30 odd, on each house.

Mr. W. H. H. Broadberry (Tottenham) said about 11 or 12 months ago they determined to try the prepayment meter system; indeed, they fairly got into work with it about Christmas last. Up to the present they had fixed something like 1,000 meters; and here he might say that Mr. Livesey's estimate of the cost was something below theirs. He thought they made something like a total expense of about $24.75 per house, whereas Mr. Livesey's estimate was $21.72. So far they had no cause to complain. Of course, there had been a few little troubles, a few irregularities in the registration of the meters; but considering the number of meters that had gone out, he thought the number of complaints they had received was something remarkably small. On the question of satisfaction he thought all their people—all their fresh consumers—were perfectly satisfied with the system they were carrying out. They put an additional 12 cents per 1,000 cubic feet on the price of gas, and their calculation was that each house would have an average consumption of 18,500 cubic feet per annum. As he had said, the system had been in operation for nearly 12 months; and, judging by their experience, it promised to be a success. At the present time they had something like 250 applications in the office for meters to be fixed; and they were endeavoring to overtake the demand as fast as they possibly could. If they took the inspection of a thousand additional meters in the year that would amount to a very considerable sum in wages, independent of collection, but in their case inspection and collection ran together. He might say, regarding the question of discontinuing, that there was only one house in their district which had discontinued since they started, and that was because the house was condemned, and had to be pulled down. Some years ago they commenced letting out gas cookers, and they had since accumulated some particularly worn-out ones—old things they hardly knew what to do with. They had been kindly allowing any consumer who they thought would really use the stove the use of one of these old cookers, in place of the usual ring burners, and he thought he might say they had very nearly cleared the whole stock off. Mr. Livesey said he gave three different burners; they gave four, and that, he supposed, accounted, in a certain sense, for the little difference in the way of cost. Theirs, as he had said, was

$24.75, and Mr. Livesey's was $21.72. Mr. Broadberry proceeded to complain of the meter makers reducing their guarantee from five years to one, and expressed the opinion that they, as representatives of the gas companies, should have some discussion on that and other subjects, such as the price charged for prepayment meters. There was only one way out of it—and he should certainly be pleased to see it adopted—a co-operative meter makers' association in connection with the gas companies.

The President said he did not think the guarantee came within the scope of Mr. Livesey's paper; therefore he suggested they should not enter upon the subject at the present time.

Mr. C. E. Botley (Hastings) said he had not had long experience of prepayment meters, but such as he had had was very satisfactory. He watched the system for a considerable time, thinking that a place like Hastings was not well calculated for it; but he was induced to adopt it, as he saw a great number of people adopting oil, owing to its cheapness. In their case they did not supply fittings at all; they only supplied the meter. They charged 10 cents per 1,000 cubic feet on the gas for the rent of the meter and the cost of collection. In the short time the system had been in existence with them they had sent out from 200 to 250 meters; but he could not as yet say how it would work. If, however, the price was too high, they would bring it down to a fair and reasonable rate. They also supplied small stoves, and they charged for these 10 cents on the gas consumed. That was 20 cents on the gas for rent and collection. Collection was a very considerable item at present. But how, he asked, did Mr. Livesey find the system answer in regard to the gas consumed and the coins in the box. They had had one or two cases of failure. In one case the meter failed to act; it kept passing the gas, and the consumer did not inform the Company, and refused to pay. Now the consumers were made to sign an agreement that they would be responsible for the consumption as registered by the meter. That would put an end to disputes. Generally speaking, the system worked very satisfactorily.

Mr. F. G. Dexter (Winchester) asked what method was adopted to make the introduction of meters known in a town. He also asked whether any difficulties had arisen with consumers in regard to the difference of prices—as to whether it was an adequate sum, or too much for the value of the meters and fittings supplied. Under this system the greater the consumption the greater would be the rental for the fittings.

Mr. J. T. Joliffe (Ipswich) regretted that the President had ruled the matter with reference to the meter makers out of discussion, as he might have said something upon that subject. The principal question he should like to ask Mr. Livesey was as to the method of collection. He supposed most of them collected monthly. He was now trying to introduce a system by which the collectors should be upon piece work, and paid so much for each collection. He would also like to ask Mr. Livesey as to the disposal of the coppers. Last month he took $1,100, and the month before he took $1,050. He went to the bank with the coppers, and they just laughed at him. They did not want copper, they wanted gold. Therefore they had to go to the pawnshops to dispose of them; and they agreed to relieve them of a portion for a consideration of 6 cents on each $5. The cost of fitting in his case was somewhat under $20 per house. They supplied four governor burners, as they thought by means of governor burners undue waste was checked, and that this lessened the prejudice that might possibly arise from extravagance in consumption. They also supplied a boiling ring; but they had charged a rental for the gas stoves. In this he thought they were quite justified, because although the consumption per house when a stove was in use was considerably more than when it was not in use, they found, as a matter of fact, that the interest on the outlay was less than on the outlay on the burners pure and simple. That might not be the case with everybody, but it was so with him. They were charging an additional 12 cents per 1,000, and that was perhaps hardly enough, but having begun with that he did not think it was wise to depart from it.

Mr. J. W. Helps (Croydon) desired to have a small "say" on this subject, although, when he noticed that Mr. Livesey's paper bore the title "Notes on Coin Meters," he felt he was put somewhat out of court, inasmuch as the discussion on this paper would naturally take but one line—viz., penny-in-the-slot meters. Now, he had had a considerable amount of experience with prepayment meters and fitting up houses, of a rental under $150, during the last five years. They started in the Christmas quarter of 1889, and had gone on increasing slowly but surely up to the present day. From the beginning they had not, however, attempted to push the matter to any great extent. They had let it grow up by itself. That was a point on which he did not wish to say much, as he did not want to let himself in for such severe criticism as he did by one or two remarks he made a short time ago. At the same time he still held the views he then expressed. They had now in Croydon about 7,500 consumers, and of these something over 1,000 were on this prepayment system. Of these about 800 had been supplied with fittings; the others were simply those who were previously not using gas, or, perhaps, having been in the habit of paying a deposit (to which they objected) were allowed to use prepayment meters in substitution for the ordinary meters. This was, however, a rare occurrence, and one which should be allowed only when it was necessary to cut out oil. The total cost of fitting in his case was somewhat higher than any figure mentioned, as it came to the other side of $25. That was caused, he fancied, by their giving more than Mr. Livesey did; they gave a couple of extra burners. It might also be due to the fact that after a year or two's experience they found that the rather cheap fittings they were in the habit of using at first caused at times some considerable trouble, through escapes and breakages; now they paid a little more for their fittings than most of those who had just spoken. That morning he had the curiosity to get out a few figures as to what they were doing from a pecuniary point of view, and he found that for the year ending 30th September last their prepayment customers had burned very nearly 16,000,000 cubic feet of gas. That was on their total consumption of, say, 480,000,000. The money they had taken during that time was something like $13,500. The cost of collection had, of course, to be taken into account, and that was one thing which was generally brought up as an argument against the system he had adopted in Croydon, that was to say, instead of the penny-in-the-slot meter they had a meter which necessitated a man going round and "putting on" the quantity of gas required by the consumer. It was generally stated that that was not advisable, because it was so costly; but Mr. Livesey mentioned in his paper that the collection was something like 15 cents a thousand. In their case they had two men, to each of whom they paid something like $375 or $400 a year, and those two men were sufficient to do all that was necessary, and he did not think the cost came to more than 6 cents per 1,000 cubic feet.

Mr. Livesey—It is 15 cents per consumer.

Mr. Helps, continuing, said they did not charge anything extra on the price of the gas. That could be argued both for and against from the practical point of view, but to him it did not seem that the large consumer should have to pay practically more for his quantity than the small one. They found amongst these consumers a great many who were anxious to get cookers, and in some 250 cases they had fitted up stoves of varying sizes. But, like Mr. Dougall and several others, they found it necessary to charge a rental for these stoves, in addition to anything they charged in the ordinary way. Mr. Dexter had asked a question which perhaps he might answer. That was as to how notice was given of the intention by any company to start such a system as this. In Croydon they started in a small way, simply picking out in the center of the town certain houses which came under the designation of artizans' dwellings—houses under $150 rental. They sent out notices saying what they meant to do. When these houses were practically exhausted they went on and on, until now they supplied a radius of two miles from their offices. After carefully working it out they found that the average amount of gas used per customer was about 18,000 cubic feet; and the net profit they made out of the gas—leaving out of the question interest on capital, which was covered by a rental of 4 cents per week for the fittings, meter, etc.—was $4.16; and the 4 cents brought them in between 9 and 10 per cent. on the outlay.

The President said he had had a little experience of this system of gas supply, and he regarded it as one which had developed in a way that no one had dreamt of. His Company, when they took it up about a year ago, went about it in a very cautious way. They did not push it by any means. They selected a district, and selected their customers as well, and they took care to charge a good amount for interest on outlay, to the extent of 25 cents per 1,000 cubic feet of gas. His experience, however, soon showed him there was a very great demand for cooking stoves. Up to that point the consumers were only consuming at the rate of about 1,000 cubic feet a month, which was the experience of most present; but after the stoves were fixed they got about 2,000 cubic feet a month, which gave 24,000 cubic feet a year. As a proof of their caution, he might say that they charged 25 cents for the hire of the fittings, which, perhaps, was rather excessive. Like others, he found the cost of collection was rather heavy; but his Company had the comfort of knowing their charges would cover the cost of collection, as well as other expenses.

Mr. Livesey, in reply, said the remarks of Mr. Broadberry and Mr. Dougall were more in sympathy with him; indeed, they had no criticism to make on the paper, therefore he had nothing to say in answer to them. Mr. Joliffe asked how the coin boxes were emptied. They

thought it necessary to empty them once a month, though not always —sometimes every six weeks. Their collectors were appointed from the workingman class, they did not take them from the clerk class, and they found them perform their work very well. At present each man was doing about 770 accounts per month, and if that number was multiplied by 12—that was to say, if the collection was made monthly—they would find the number of collections made in the year. They now thought of introducing a kind of bonus system. At first the collectors might have two or three of these meters in one street, and then have to walk half a mile to find half a dozen in another. They were now working under different circumstances, and the work of collection was becoming closer. Their chief rental clerk thought the collectors might get up to 1,000 accounts a month. The disposal of the coppers was a difficult matter. They had tried publicans and pawnbrokers to take them, but finally they had to go to the bankers and make terms with them. Fortunately, in the South of London, the London and Southwestern Bank had many branches not far away, and these coppers were taken to them. He was not at liberty to say what the arrangements were, but this he might say—they collected about $4,500 a month in coppers. They were placed in little blue bags containing $1.25 each, and the bags bore the name of the South Metropolitan Gas Company. These bags might be seen in many of the shops, and now it was a question as to whether they should not have advertisements upon them, stating that the Company was supplying stoves, selling coke, etc. Like most of those who had spoken, they found that exceedingly few had discontinued the supply in their district. The consumers were satisfied, even with the increased rate, and would not give up the gas for anything. From what they had heard, —in fact, it hardly seemed right—some of the people not properly clothed would rather put a penny in the gas meter than go without light. One of their gasfitters told him some of them ought rather to buy a pennyworth of soap than a pennyworth of gas. Mr. Helps spoke about cheap fittings. They found the fittings supplied were not good enough, therefore they got them made to their own patterns, and strengthened in the joints. The fittings now put up were very good and strong. At first they gave a bonus to their workmen for introducing consumers, but finding that they brought consumers a great deal faster than they could supply them, they discontinued it.

Analysis of Electrolyzed Water Pipes.

[A report prepared by Mr. Joseph Rigge, at the instance of Major J. B. Furay, of Omaha, Nebraska.]

When a few weeks ago you requested me to analyze some electrolyzed scraps of pipes which had been badly corroded under the action of the electric trolley current, I had no idea of the extent of damage done water pipes, gas pipes and telephone cables. I determined, however, to give the subject all the attention at my command, and have come to the conclusion that we are confronted with a new destroyer of our service pipes, which demands immediate attention and an efficient remedy. In the hopes of perhaps making a useful suggestion, I submit this analysis to your consideration.

I. The state of the case.

The difficulty does not arise from the alternating lighting plant, but from the direct railway motor system, in which the current leaves the generating dynamos at the power house and by means of feeders is distributed to the trolley lines, carried down the trolley arm to the car motors, where it does its work; then escapes by the wheels to the rails, by which it is expected to return to the generators. This would be the case if the rails presented the best home conductor; for electricity will always follow the path of least resistance. But the rails offer so much resistance at the joints, that the current naturally passes through the damp earth to the water, gas or cable pipes in the vicinity, and runs along these good metallic conductors until the rails again present an easier return to the home station. Where it leaves the pipes to pass back to the rails, the current keeps eating away the pipes, carrying away with it these minute particles of metal. In a short time little holes mark the places where the electricity escapes. These grow larger and corrode the pipe, giving it the appearance of being "pox marked." The fact of the rapid corrosion of our underground iron and lead pipes along the route of the electric trolley cars is undeniable. In proof I refer to the ends of broken pipes in the office of our Board of Public Works. That electricity is jumping the rails to water and gas pipes and back to the track was abundantly evidenced by the volt and ammeter tests made by a party of competent electricians, to which the writer was kindly invited, on May 11th, last.

At the Nicholas street power house the difference of the potential of the water pipe over the rails where they entered the station was from 3½ to 6 volts, and the quantity going to waste 30 amperes, making No. 18 wire so hot that it could not be held in the hand, and driving a ½-horse power motor attached to the water plug. At the Custom House, on 16th and Dodge streets, enough current is leaving the street car rails for the water pipes and the moist foundation to corrode them before the building will be finished, and to fire the neighboring buildings. Even on Capitol Hill, where the ground is dry, a current of from 4 to 9 amperes, at a voltage of from 1¾ to 3½, works its way from the terminal rail to the water plug.

In some instances of pipe corrosion, a spot of greater or less extent is singled out by the current and weakened until it becomes detached like a chip. These electrolyzed nodules are extremely light. Four samples examined by me gave a specific gravity of 2.36, 2.06, 1.88, 1.54, the latter resemble coke in weight and appearance. Bearing in mind that the specific gravity of cast iron is 7.00, we may naturally inquire what has become of the iron? and what changes have taken place? This question was referred to me for solution. In order to follow the most rational method, it occurred to me to subject these nodules to the same electrolytic action which they had undergone.

II. The analysis.

We have under our streets an extensive plating battery in constant operation, of which the water pipes are presumed, in our case, to be positive, the rails negative and the intervening moist earth the solution. Wherever there is a difference of potential, that is, wherever the water pipes carry a stronger current than the rails, the electricity will flow from the higher to the lower, from the positive to the negative metal through a conducting medium, carrying metal from the higher potential towards the lower, either depositing it on to the negative pole or dropping it on the way. Acting on this underlying principle of electrolysis a nodule previously weighed was attached to the positive pole of the trolley current, after it had done its work, suspended in dilute hydrochloric acid, while at a distance of a few inches was the negative pole, consisting of a platinum plate connected with the water pipe. On closing the circuit a flow of electricity could be seen passing from the iron nodule through the solution towards the negative platinum, carrying with it into the solution particles of iron, as could be seen by the decomposition of the solution into hydrogen and chlorine, the hydrogen escaping by the negative pole and chlorine combining with the free iron to form iron chloride. The liquid was occasionally renewed and tested for iron, till after five days it gave no further reaction with sulphocyanide of potassium, thus indicating that the nodule had no more iron to give. After drying, it was weighed. The loss of weight was, iron 56 per cent. Now, if the piece of electrolyzed iron had lost all its iron, the solution of iron chloride had gained, and therefore should contain as much. This was actually the result, titration by potassium bichromate being the method employed.

The nodule deprived of its iron retained its former shape, but was extremely light and frail. It was, in fact, but the ghost of its former self. Was it carbon? Analysis gave 29 per cent. graphite, 13.37 silica and 1.15 manganese, with traces of sulphur and phosphorus; hence the complete analysis of the electrolyzed pieces of cast iron pipe would be:

Iron	56.17	Specific grav., 1.88
Graphite	29.00	
Manganese	1.15	
Silica	13.37	
Sulphur, phos	....	
Total	99.71	

Compare with this the composition of a fair sample of (grey) cast iron:

Iron	90.58	Specific grav., 7.00
Uncombined carbon graphite	3.70	
Silica	4.14	
Manganese	0.83	
Sulphur, phos	small	
Total	99.25	

We can now readily understand how, under the action of electrolysis, our city service pipes have much of the iron, their backbone of strength, corroded away, leaving behind in its place a frail shell of graphite iron, incapable of sustaining even the ordinary pressure of the mains.

That the above results appear to be warranted is confirmed by an analysis of the earth around the electrolyzed parts. Several samples of earth were found to have gained as much iron as the pipe had lost.

It should be borne in mind that the above analysis is not intended to be a representative one of all similar spots of corrosion. Three other samples examined gave varying percentages of iron and graphite, one being so very light, unctuous to the touch, incombustible, and of such greying black metallic luster that I would almost call it pure graphite.

It was a good conductor of electricity, burned like the carbon of an electric lamp, marked paper like a soft lead pencil, and coated a platinum dish with the unctuous black of stove polish. All the other samples marked paper like black lead, and had more or less of the preceding proportions.

But the question, Where does the excess of carbon come from? is not so easy of solution. The fact that the photographs of the corroded pipes in the City Engineer's office are corroded in particular places, may be owing to defects in the casting, for it is known to moulders that the fused metal is lumbed around a ball of lampblack used to facilitate the casting, then scaled over, thus forming knots and weak spots. As they contain more carbon, the current singles them out for electrolysis.

Of the corroded lead cables I have not seen any samples, but from the description given they would appear to be simple cases of lead corrosion occurring in the presence of air and moisture, and possibly decaying substances, such as manure, the electric current furnishing the warmth. The result is white lead incrustation.

III. Admitting this state of things, what is the remedy?

1. It has been suggested frequently to reverse the trolley current. That would no doubt remove the evil, if it were safe and possible.

2. It was supposed, and I think has been tried here, that the insulation of underground pipes and cables might be sufficient. That is impracticable. Where there is electrolysis, there is leakage.

3. The only practical way which suggests itself to me, is to keep the current in the rails by electrically welding the rails together all along the line, and to each other, thus preparing an unobstructed broad metallic conductor for the homing current. This is being done in Brooklyn.

The next best method would be to band the rails securely to each other with a 1-inch copper wire. A cross band of the same thickness should connect the two lines of rails every 100 feet, wherever the earth is sufficiently moist to render an escape to the pipes probable. In addition it is very necessary to have a heavy metallic connection between the return rail and back to the generators. If, besides, in the danger district, the rails are connected at frequent intervals with all pipes and cables along the track, there is every reason to expect an abeyance of the evil. Wherever this plan has been tried it is pronounced successful.

As we cannot, however, force the current to take one path exclusively when others are open to it, and as 1-100 of a volt difference of potential between the pipes and the damp earth surrounding them has been found sufficient to induce electrolysis, I would suggest that frequent voltage measurements should be made all over the line, even after some plan has been adopted, and that such changes in the return conductors be made as the measurements may indicate.

The Diffusion of Light from Dull Surfaces.

The London *Journal* remarks that Christian Wiener has contributed to Wiedemann's *Annalen* the results of an investigation of the phenomena of the reflection—or, as he prefers to call it, the diffusion—of light from dull surfaces. This inquiry was suggested to Herr Wiener by the problem which presented itself to him in connection with the teaching of descriptive geometry, of representing bodies with their appropriate degrees of brightness. The author begins by stating the accepted law that the intensity of illumination of an element of an illuminated surface is proportional to the intensity of the source of light divided by the square of the distance from the element, multiplied by the cosine of the angle of incidence. The brightness of the illuminated element as it appears to the eye of an observer is proportional to the intensity of illumination thus arrived at and to its own reflective capacity. According to Lambert's law, this brightness is the same for all angles from which the surface may be viewed. That this law is not always true, was known to Bouguer, who found (in a manner corroborated by Herr Weiner) that when the directions of incidence and of vision are nearly parallel, the brightness is not proportional to the cosine of the angle of incidence, but that with increase of this angle it decreases more rapidly than the cosine. In shaded drawings, Lambert's law is employed almost exclusively, and with good effect. The author refers to the investigations of Herr Lommel, as starting with Fourier from the supposition that the diffusion of light by a body does not proceed from the surface, but from volume elements of the mass of the body, as the coloring of the diffused light demands. For opaque glowing bodies, Lommel thus arrives at the law of the cosine. He also finds that the length of the path described in the interior of a body by a ray of light before its complete absorption depends wholly upon the absorptive power, not upon the angle of emergence; so that the vertical depth of this diffusing layer, and consequently the amount of the diffused light, must be proportional to the cosine of this angle. This result was confirmed by Herr Moller by observation of glowing metal plates. In his later paper, Herr Lommel arrives at a formula for the intensity of the reflected light, which depends only upon the angles of incidence and emergence. These results are based upon the tacit assumption that the surface dealt with is matt, or rough. And for such surfaces they are perfectly confirmed by Angstrom's observations on the heat radiation of plane surfaces.

The explanation of the diffusion of light by dull surfaces has been based upon two assumptions. The first is that the disturbance penetrates the surface to a certain depth, and that this layer radiates the disturbance in all directions. This view is supported by the color shown by the dull surfaces, and by the fact, ascertained by many experiments, that the diffusion increases, within certain limits, with the thickness of a specially prepared dull layer. Bouguer employed a different hypothesis upon which to base his theory of the diffusion of light. He supposed the rough surface to be composed of a large number of small plane reflecting surface elements lying in all directions, like a tumbled mosaic. He further supposed the total area of these surfaces in a given direction to be greatest in that of the general surface, decreasing as the angle to it increases; thus producing a preponderating reflection in the sense of the effect of the general surface. Herr Wiener holds that in the case of dull surfaces we have to deal both with penetration of the rays and diffusive reflection from small surface elements; but these conditions vary so with different degrees of roughness, and different forms of the prominences offered by rough surfaced bodies, that observation alone will determine the facts for every case.

Herr Wiener began with observations upon the diffusion of light in the case of cast white gypsum, of which two equal plates 25 centimeters square were procured and illuminated in a dark room by a single standard stearine candle of six to the pound. As the unit of brightness, he adopted that shown by such a plate when illuminated perpendicularly by a candle, at one meter distance, seen perpendicularly or very nearly so. The distance of the observer's eye from the plate has no influence upon the brightness. The direct vision of the light was prevented by the interposition of a screen. Several observations were made of the effect of varying the distance of the light and the angles of incidence and emergence upon and from the plates. From these the author has drawn conclusions which apply only to cast gypsum, but not to rough surfaces in general. Concerning the diffusion of light by gypsum, it may be stated: (1) With a constant angle of incidence and an angle of emergence varying between 0° and 60°, the brightness is pretty uniform, and usually somewhat smaller than that demanded by Lambert's law. (2) As the latter angle increases from 60° to 90°, the brightness on the whole diminishes, and at the latter limit, or with a glancing visual ray, it is about 0.6 times that at angle zero. (3) On the side opposite to the incident ray—*i. e.*, on the side of reflection—the brightness is greater than at the corresponding points of equal angle of emergence on the same side. (4) The reflection is more pronounced and evident the larger the angle of incidence. It is therefore noticed that reflection is always greatest with an angle of emergence slightly larger than the angle of incidence. These considerations are not without their bearing upon the construction and use of photometrical instruments.

Lowe's Improved "Gas Cleaner" or Purifier.

On the 20th inst. U. S. Letters Patent (No. 529,625) were granted to Mr. T. S. C. Lowe, of Norristown, Pa., for improvements in "gas cleaners." Using the words of the specification:

The invention relates to a gas purifier or cleaner so constructed as to afford an inexpensive apparatus capable of performing the functions of a washer, a scrubber, a condenser and a strainer for the purpose of removing from the gas, at a single operation, motes, dust, ashes, small particles of coke, cinders and other sold impurities, which, if left in the gas, choke and stop up the gas burners and divide the flames, and also any oily, tarry and other condensable matters which should be removed in order to prevent them from being carried to the ordinary lime or other purifiers when these are used as auxiliaries for the removal of sulphur and carbonic acid from the gas.

In the annexed drawings Figure 1 is a vertical section of my improved gas cleaner, on the line $x\,x$ of Fig. 2, which is a horizontal section of the same on the line $y\,y$ of Fig. 1.

The letter *A* designates an upright shell or hollow cylinder, of any required height, and in the lower part of which is a body of water *B*, which serves as a hydraulic seal and as a medium for washing and cooling the gas. Below the surface of the water seal *B* is a gas scrubber diaphragm *C*, supported by a gas inlet pipe *D*, through which the gas to

be cleaned is conducted to the under side of the diaphragm *C*, below the surface of the water. Above the water seal are grate bars *E*, on which cobblestones *F*, or equivalent scrubbing and condensing materials, are supported to a suitable depth or thickness.

Above the cobblestones *F* is a series of wire cloth sieves, *G*, G^1, G^2, G^3, having meshes preferably lessening in size from the first or lowest sieve *G* to the last or uppermost sieve G^3, the object being to keep back the solid particles and allow the gas to pass up through the sieves, while

Fig 1.

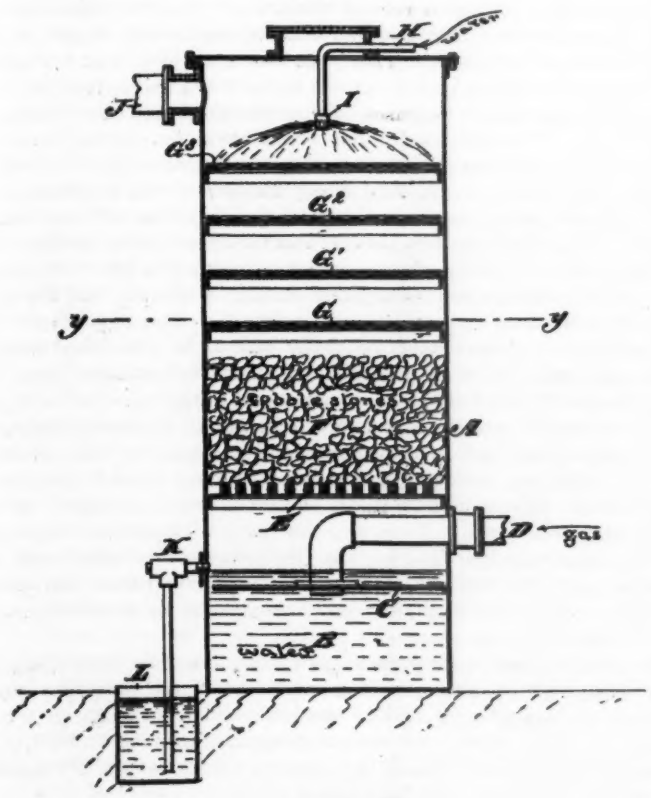
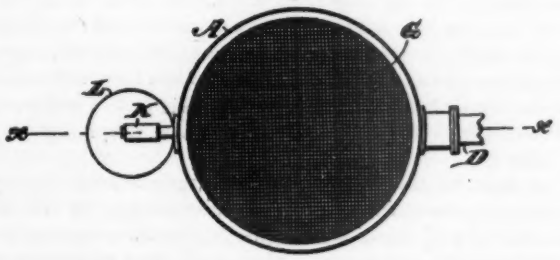


Fig 2.



at the same time the water introduced at the top of the cleaner through the pipe *H*, which preferably has a spraying nozzle *I* attached to it, passes in a contrary direction down through the meshes of the sieves.

To the upper part of the shell *A* is attached a pipe *J*, through which the cleaned gas passes out to a holder or to a place of consumption, or, when necessary, to the auxiliary lime purifiers above mentioned.

K is an ordinary overflow pipe, and *L* an ordinary trap or seal.

The gas to be cleaned enters the cleaner through the pipe *D*, under the diaphragm *C*, and is washed by the body of water *B*. It then passes up through or between the grate *E* and cobblestones *F* (kept cool by the water running down over them), which break up the current of gas and condense any oil, tar and other condensable substances. The gas then passes up through the sieves *G*, G^1, G^2, G^3, which strain out the motes, dust, particles of coke and other solid impurities, which, being met by the falling water, are carried back into the body of water *B* in the lower part of the shell *A*, the lighter portions running out through the overflow pipe *K*, while the heavier portions fall on top of the diaphragm *C*, or sink to the bottom of the cleaner. Other materials, such as broken stones of any kind, anthracite coal, coke, bricks, or pieces of wood, may be substituted for the cobblestones; or, if the number of sieves be increased, the cobblestones or other condensing materials may be dispensed with, but I prefer to use cobblestones as described. Instead of making the effective portions of the sieves of wire cloth, splints of wood, cane, bamboo or cloth of any kind that will act as a fine strainer may be used, but I prefer the wire cloth. Instead of admitting the water through a spraying nozzle, it may be admitted at the top of the cleaner in any way, but I prefer to spray the water in as described.

I do not wish to confine myself to the use of four sieves, as a greater or less number may be employed with benefit; neither is it absolutely necessary that the meshes of the successive sieves should diminish in size from the bottom toward the top as above described, although I prefer to construct and arrange them in this manner.

Malleable Castings from Coke Iron.

The *Iron Age* remarks that the manufacture of malleable castings has long been an important branch of the American foundry trade. Lightness with strength is the object aimed at in the production of innumerable articles. Few people on the face of the earth are so perpetually at war with clumsiness, and even the appearance of heaviness, as Americans. Safety and durability are not lost sight of, but are always carefully considered, after which comes the question of avoiding the use of surplus metal, except in cases in which very great strength can only be secured by means of ponderous masses of material. But in building machinery for light manufacturing, or for rapid movement, or for agricultural purposes, everything in the nature of surplus weight is rigorously eliminated. Agricultural implements and vehicles, as made by American manufacturers, are almost marvels of lightness and strength, so thoroughly has the question of easy draft been studied. In mechanics' tools, hardware specialties, builders' hardware, saddlery hardware and house furnishing goods the same conditions are apparent. Mere dead weight is avoided unless it is an essential feature of the article itself. To this feature of American manufactured products the makers of malleable castings have made valuable contributions. They have been alert and progressive, and the very large establishments in numerous localities making a specialty of malleable castings testify strongly to the hold which this class of products has secured on the trade of the country.

The peculiar excellence of American malleable castings has until recently been attributed in no small degree to the character of the pig iron used. Lake Superior charcoal was regarded as the ideal material, being smelted from very rich pure ores, with the purest of fuels. Producers of Lake Superior charcoal iron therefore regarded the malleable casting trade as one of their own particular possessions, secured to them by natural laws. But the Western manufacturers of coke pig iron have rudely interrupted the even tenor of their way, and are not only inducing the malleable casting makers to use a mixture of coke with charcoal iron, but seriously threaten to absorb the entire trade. A revolution, therefore, seems to be impending in the manufacture of malleables.

Two factors are at work in bringing about this result. One is the desire of the malleable foundrymen to secure cheaper material than charcoal iron, and the other is the effort of coke iron producers to widen the consumption of their product. The experiments made in the introduction of coke iron have therefore proceeded with the active cooperation of both interests. Bessemer iron was taken as the basis of experimentation, as it approaches most nearly to the chemical composition of Lake Superior charcoal iron. These experiments have extended over a period of about three years, and Western makers of malleables do not now hesitate to say that they can make thoroughly satisfactory castings from coke iron exclusively. They have had some prejudice to overcome from their customers who were skeptical of good results from any other material than charcoal iron. This prejudice, however, is rapidly disappearing when the fact is demonstrated that the coke malleables are by no means the inferior goods which they feared. Some malleable foundrymen were prejudiced against the use of coke iron at its inception, but they have been persuaded to adopt it by the force of circumstances, among which may be mentioned the powerful lever of lower prices made by coke-consuming competitors. An instance is noted of one maker of malleables who bought a carload of coke iron for trial, which became mixed with the charcoal iron in his yard and could not afterward be identified. The castings were carefully watched until the stock was cleaned up, but no ill effects whatever were perceptible from the mixture. It is needless to say that coke iron rapidly grew in favor with this establishment.

The substitution of coke iron in this class of castings is another triumph of the chemist. The manufacturers of malleables who use iron do not hesitate to say that they are now more certain of results than when they depended exclusively on charcoal iron. The method adopted by the coke iron producers is to analyze every carload of iron destined for malleable purposes, so that the consumer knows precisely

what he is getting. He is then able to determine the exact treatment to be given to the iron in each carload to secure a specific result. His work is not done at haphazard, but with as nearly exact knowledge as it is possible to get. To meet such conditions the producer of charcoal iron must not only sell his product at an even price, but must also furnish an analysis of each carload, as the mere fact that the iron is smelted with charcoal is not accepted as a guarantee of uniformity, nor even of superior fitness for the purpose. The conditions thus imposed bear heavily on the charcoal iron producer, who is handicapped by the high cost of his fuel, and cannot well afford to incur much additional expense. The consumer, however, is greatly benefited, as the cost of malleable castings has been reduced in conformity with the reduction made in the cost of the raw material.

The Gas Manager in Argentina.

By Mr. G. E. Stevenson, in the *Gas World*.

South America is an immense continent, and experiences therein differ largely according to the part of the continent in which one's work may lie. Agentina is a different country to Brazil, and the conditions there are very different. From 1885 to 1890 Argentina enjoyed a brief period of unusual prosperity. Its capital city, Buenos Ayres, has half a million inhabitants, the population having increased 25 per cent. during the period mentioned. It was in these prosperous times a veritable Paris, displaying an extravagance of luxury, combined with a feverish bustle of business and fortune hunting, unexampled in the history of South American towns.

It was at the commencement of this boom that the writer arrived in Buenos Ayres to take charge of the works and business of the Buenos Ayres (New) Gas Company, Limited. Two other Companies—both local—were also supplying gas in the city. All three Companies competed for custom in the heart of the city, whilst a fourth Company (the Belgrano Gas Company) was established in the suburb bearing that name, with powers to supply gas within a portion of the municipal area.

The first and most important thing the writer was called upon to do after his arrival was to plan and carry out an entire reconstruction of the Company's system of main piping. The district was a large one, embracing some 120 miles of pipes. The works were situated in the eastern suburb of Barracas, and the trunk mains had to pass straight through the whole length of the city, a distance of about 4 miles. The city is practically a parallelogram, 4 miles long by 2 miles wide, its length being parallel with the shore line of the River Platte. The mains were too small, and an adequate pressure could not be got through to the west end of the city, which, by-the-by, is the fashionable end, as in London.

A New Main System.—The new system of mains was planned and estimated to cost about $300,000, and a contract was made with Messrs. John Aird & Son to carry out the work. It was thought that, as the most growing part of the city was that portion in the west and southwest, the greatest consumption might be expected to take place there, and that it would be preferable to have an independent source of pressure in that neighborhood, rather than convey the gas there direct from the works, which would have necessitated laying a large trunk main controlled by a separate governor, and not tapped on the way. Therefore it was decided to erect a gasholder on a site in the southwest part of the city. The site was, in fact, at the time of this decision, outside the city, between 2 and 3 miles inland. The construction of the gasholder was proceeded with during the relaying of the main pipes.

The plan for the main piping included three parallel lines of trunk mains, one to be carried along the street next the river front, the second through an important street about a mile south of the first line, and the third through the boulevards Entre-Rios and Callao, about another mile farther south. The city faces north, so that the south was the side farthest from the river. At right angles to these trunk mains, and equidistant from one another, were laid seven principal cross mains, connecting the trunk mains already described. This plan was adopted because of the rectangular disposition of the streets, which are all parallel and at right angles, the city being divided up by the streets into a number of blocks, each 150 yards square. There were, therefore, parallel streets running east and west at 150 yards apart, and parallel streets crossing these at right angles, also 150 yards apart.

The trunk mains and principal cross mains thus inclosed 18 sections, each section containing so many squares of buildings; and, provided an equal pressure could be maintained in the inclosing mains, each section of the city would receive a supply of gas at an equal and uniform pressure. This was secured by the establishment of the gasholder in the southwest of the city, the supply being kept up from two opposite points of the district—viz., the works in the northeast and the gasholder station in the southwest.

In order to keep the gasholder filled a pumping main was laid from the works to the holder, and, about half way, at the southeast corner of the city, an exhauster house was established and two exhausters put down, driven by gas engines, to draw the gas from the holders at the works and drive it up to the holder at the southwest station. Half this main was under the full pressure of the gasholder, but in the suction half, when the exhausters were at work, a vacuum was created, due to the friction caused by the length of main through which the gas passed.

The work of relaying the main pipes was a big job, and entailed a great amount of anxiety and trouble, as the municipal authorities were very reluctant to have the streets disturbed, and placed many obstacles in the way. The drains and water mains were the greatest source of trouble. The gigantic system of drainage and water supply devised by the late Mr. Bateman was then being finished, under the direction of his staff, and under the supervision of the Municipal Office of Engineers. This Office required that the Gas Company should make a sectional drawing of every street in which it proposed to lay a new main, on which the drains and water mains should be shown, and the position to be occupied by the new main indicated. This entailed an immense amount of work, and eventually had to be abandoned because of the impossibility of obtaining the required information from Mr. Bateman's office in time to be of use to the Company. But in laying all the principal mains this system was followed. The main was drawn on a longitudinal section of the street, and its levels and falls all determined, before the work was carried out. In many cases it was necessary to carry the main down below the cross drains, as there was not room to go over them. Moreover, the house connections to the main drains not having been put in, the Company had to leave room for these to pass over the gas mains. Notwithstanding these difficulties, and the extent of the work, it was all completed in about 18 months from commencement.

In order to equalize the pressure two governors were fixed along the line of the high pressure pumping main, one at the exhauster house and one at the gasholder end of the line, and from these governors pressure was delivered out of the pumping main into the trunk supply main in the boulevard, which ran parallel thereto at a short distance away.

Whilst this work was going on, the retort settings of the works were reconstructed on the regenerative system. As soon as the new gasholder was brought into action and an adequate pressure could be obtained in the city, a large increase in the consumption was experienced; in the third year of the writer's management the increase amounted to 30 per cent. In the retort house 1,000,000 cubic feet of gas were manufactured in one day under a building designed originally to produce 500,000 cubic feet.

At the close of the third year the writer resigned the management, and further extensions at the works were carried out by his successor.

Illuminations and Lamp Lighting.—During these three years many unusual things were experienced. One of the most important features of the gas supply in Buenos Ayres was the frequent illuminations which were required on days celebrating national events. The 25th of May is the great day of Independence in Argentina, on which day, in 1810, the country decided to throw off the Spanish yoke and become an independent nation. This day, and the 9th of July, on which the momentous decision was carried into effect, are the great gala days of the Republic, and on them the city is always brilliantly illuminated, whilst elaborate displays of fireworks take place in some of the principal Plazas. In the first year of the author's management, more than usually elaborate preparations were made for celebrating the festival of the 25th of May. A huge structure, called a triumphal arch, was erected in the Plaza Victoria, and decorated with evergreens. The Gas Company was desired to illuminate this edifice with gas. The estimate included 12,000 lights. To supply these required six or eight service pipes, three inches in diameter. The Company kept a large stock of piping and burners on hand, and their staff of gasfitters was hard at work day and night for more than a fortnight running lead pipe and iron pipe all over the structure, and fixing burners and globes. When all was ready an experimental trial was made, with the result of very nearly burning down the entire structure; for the oily Eucalyptus boughs, with which it was decorated, caught fire, and were only torn down just in time to save the edifice. The illumination came off all right, but the evergreen decorations had to be abandoned. Of course, the consumption of gas was enormous, for the principal streets were also illuminated with arches of wrought

iron pipes covered with burners. On such occasions it was necessary to put on all the retorts, and fill the gasholders brim full; and even then by 12 o'clock at night the supply was practically exhausted.

The way in which the lamp lighting was done in Buenos Ayres was an example of celerity which might be copied with advantage elsewhere. There were some 4,000 lamps to be lighted, and they were all alight within 40 minutes. The lamplighters were marshalled at the offices, and marched thence to their posts, which were so arranged that, on a signal being given by lighting the first lamp in the principal thoroughfare, which all the men could see, the lighting began simultaneously at the several points. The lamplighters do not walk leisurely from post to post; they ran with astonishing celerity. They were not, however, so eager at putting-out time, and occasionally a street was discovered to have been forgotten, and to be all ablaze in broad daylight.

Fires and Floods.—The writer's most uncomfortable experiences were in fighting the flames and floods at the gas works itself. The works were situated in a low and marshy neighborhood. In stormy weather floods were of common occurrence. The River Platte, though not tidal at Buenos Ayers, is subject to great variations of level, due to high winds, which, when they blow from the east, up the river, bank up the waters, and cause a sudden, and often disastrous, rise of the water level. At such times the water overflows the banks, and comes up over the low land adjoining the works and floods it with amazing rapidity. On more than one occasion the writer was called up in the middle of the night with the cry, "the water is coming into the works," and had to turn out on horseback, to find all in confusion, whilst the waters were coming into the retort house and putting out the fires. On one such occasion the works were cut off entirely for two whole days by a raging torrent, and a change of stokers could not be effected. The only thing that could be done was to obtain provisions, somehow or other, for those men who were on the works, and get every one to take his turn at drawing and charging the retorts until the crisis was past, and the water subsided. One attempt was made to fetch stokers in a punt, but it resulted in failure, for the punt, laden with men, struck a "snag" and sank, leaving the poor fellows up to their armpits in water. They managed to scramble back to their homes, but none would venture to renew the experiment.

Fires were a greater terror even than floods. During the first year there was no less than three fires in the coal store, arising from spontaneous combustion. The coal store roof, which was covered with iron plates, had become perforated with rust, and was leaky, and the floor was undrained. The consequence was that the rain came in, got down into the coal, and remained at the bottom of it, and evaporation through the coal took place owing to the high temperature. Ventilators in the coal were no good; they only made matters worse by letting air in. When fire was discovered in the coal there was nothing for it but to pull down the whole heap—sometimes 5,000 or 6,000 tons—and extinguish the fire piecemeal, as water poured on the stacked coal only added fuel to the fire. The worst fire was, however, one that occurred in a mountain of coke. One night blue flames were seen issuing from the top of the mountain. Alas! it proved to be a veritable volcano. The center of the heap was a mass of incandescent fuel. With the help of the municipal fire brigade, and a volunteer fire brigade, it took three days to extinguish that fire. This was a terrible business, as the municipal brigade, a regiment of the line, took entire possession of the works, and would hardly allow any one to move; whilst they half exhausted the gasholder tanks of water for their fire engine, the town supply being at that time very deficient.

Another fire which gave rise to great excitement occurred in the pitch bed of the tar distilling plant, but the application of water soon put an end to that.

The fires in the coal store were entirely prevented afterwards by reroofing the store and properly draining the floor, giving it a fall to the front of the shed, and putting in gratings communicating with the drains.

Labor and Liquor.—Troubles with workmen were not serious. The stokers were all Italians, and as good, hard working industrious fellows as could be found. They lived on almost nothing, a bowl of "polenta" and a draught of red wine forming their invariable mid-day meal; Mechanics were mostly Germans. English workmen were not all they ought to be. Somehow or other the climate seemed to make them lazy. Generally they drank, and were always difficult to control: "making bones" about everything, and not working well with other nationalities. One old Scotchman whom I found at the works had been sent out under contract to erect some purifiers, and had remained there as a general mechanic. Though slow, he was a decent enough fellow, when sober. But, alas! he had his bouts of "spree," when for a week he shut himself up and devoted himself soul and body to the "fiery demon;" and for a fortnight or more after that he was too shaky in mind and body to be of any use. At last, in one of these fits, the inevitable occurred; he was found dead in his bed, with one dozen empty brandy bottles on the floor. A foreman whom the writer took out with him, a man he had known in England for years as a good, steady fellow, killed himself within three years by the same excess. The writer soon came to the conclusion—as others have done—never to get men out from England if he could possibly do without them; and throughout his later work he never employed any other men than those in the country.

The Influence of Temperature on the Specific Heat of Aniline.

At a meeting of the British Physical Society, Mr. E. H. Griffiths, M. A., read a paper on the subject named in the heading. After pointing out that most observations of specific heat depend on water, whose capacity for heat varies considerably with temperature, the author said large differences existed between values obtained by different observers as the latent heats of evaporation of water and other liquids, and these differences were probably due to the variability of the water standard, which had been erroneously assumed constant. Precise measurements in calorimetry were of such great importance that the exact relation between the capacity for heat of water and its temperature should be completely determined. With apparatus such as he had used with aniline, this could be done in six months, provided some one could be found who could devote his whole time to the subject. The results of his own experiments were expressed in terms of the capacity for heat of water at 15° C. (at which $J = 4.198 \times 10^7$ ergs), and hence were referred to a definite standard.

A great desideratum in calorimetric work was a calorimeter whose surroundings could be kept at a very constant temperature. This he had obtained by using a tank holding about 20 gallons of water, in which a steel vessel, shaped like a hatbox, with hollow sides and bottom, was immersed. The cavity was filled with about 70 lb. of mercury, and served as the bulb of a thermometer; a tube communicating with this bulb acted as a regulator to control the gas supply, which heated the water in the tank. The tank water was circulated rapidly by a screw propeller. Under ordinary conditions the temperature of the outside of the steel chamber could be kept constant within $\frac{1}{100}$° C. The calorimeter itself was of brass, and suspended by glass tubes from the lid of the steel chamber. A stirrer, worked by an electro-motor, kept the contents in rapid motion.

In the experiments on aniline, heat was supplied to the liquid in the interior by maintaining known potential differences (equal to some multiple of the electromotive force of a Clark's cell) between the ends of the coil of German silver wire placed inside. The rate of rise of temperature of the inside over the outside was measured by platinum thermometers, one of which was placed in the calorimeter, and the others imbedded in the walls of the steel vessel surrounding the calorimeter. By this means differences in temperature of $\frac{1}{1000}$ of 1° C. could be detected with certainty. A special method of adjusting the potential difference between the ends of the German silver wire was employed, by which the constancy could be maintained within 1 part in 10,000.

To minimize corrections arising from heat generated by stirring the liquid and that lost by radiation, etc., from the calorimeter, the experiments were made about temperatures at which these corrections balanced each other. The rise of temperature was then due to the electric supply alone. The specific heat S_1 of the liquid at temperature θ_1, could then be determined from the formula

$$\frac{d\theta_1}{dt} = \frac{E^2}{JR_1(S_1M + w_1)},$$

where $\frac{d\theta_1}{dt}$ = rate of rise of temperature at temperature θ_1;

J = mechanical equivalent of heat;
E = potential difference between the ends of the coil;
R_1 = resistance of the coil;
M_1 = mass of liquid;
w_1 = water equivalent of calorimeter at temperature θ_1.

Experiments were made with different values of E, and two widely different masses of liquid were used. The author was thus enabled to find S_1 without knowing w_1. Having found S_1, the water equivalent of the calorimeter could then be determined.

Many important details of construction and manipulation of the ap-

paratus, and the method of reducing the results, are given in the paper. The final values for S_1 and w_1 at several temperatures are given below:

Temperature. Deg. C.	Specific Heat of Aniline.	Water Equivalent of Calorimeter.
15	0.5137	79.82
20	0.5155	80.11
30	0.5198	80.90
40	0.5244	82.19
50	0.5294	83.39

The aniline employed was supplied by Messrs. Harrington Brothers as "pure colorless," but had initially a light brown tinge. After being in use some time the color had darkened considerably, but its specific heat had not sensibly changed. Recently he had tried a hydrocarbon liquid which promised to be still more satisfactory as a standard liquid in calorimetry. In the course of his remarks the author said a name for "capacity for heat per unit volume" was greatly needed, and invited suggestions.

Dr. Armstrong thought the author had made a particularly happy selection in aniline, for it could now be obtained in any quantity absolutely pure. When pure it did not discolor on exposure, and would probably be very satisfactory as a standard liquid. He doubted whether any hydrocarbon could be better.

Prof. Ayrton congratulated the author on the extreme accuracy obtained. Recently he had arranged an experiment for determining the mechanical equivalent of heat by the electrical method, which gave very accurate results without any corrections whatever being necessary.

Prof. S. P. Thompson thought the whole phraseology of specific heat required revising.

Prof. Perry agreed with Mr. Griffiiths that a name for "capacity for heat per unit volume" was greatly needed, and Mr. Lucas suggested "heat density;" but this was not satisfactory.

Dr. Sumpner said most textbooks on physics attributed the advantage of the mercury thermometer to the low specific heat of mercury, whereas the capacity for heat per unit volume was the important factor.

Mr. Watson inquired to what temperature the alloy which the author had used to connect glass to metal had been tested.

The President said the paper was of great importance, because it dealt with the application of electrical methods to thermometry. The mercury thermometer had been quite superseded for work such as had just been described.

Mr. Griffiths, in reply to Mr. Watson, said the alloy had been used successfully between 10° C. and 62° C. It gave way at 71° C. He was glad to learn from Dr. Armstrong that aniline could now be got pure. Prof. Ramsay had written to say he did not think the slight impurities in ordinary aniline would have much effect on its specific heat.

Mr. Blakesley asked if aniline could be taken as pure if it did not change color on exposure.

Dr. Armstrong in reply, said, "Yes; if the boiling point was also constant."

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Nov. 10, 1894.

Sulphate Manufacture Without Spent Liquor.—A Lady Chucker-Out.—Gas and Ventilation.

One of the disadvantages connected with the manufacture of sulphate of ammonia by the usual process is the difficulty of disposing of the spent liquor, which is little less in quantity than the original liquor treated. In some localities the usual outlets for such have been forbidden, and especially where the gas works are surrounded by dwelling houses, care and precaution must be used to avoid nuisance from this source. One plan that is very generally adopted is the use of a cooling tank, three or four times the capacity of the boiler or still, into which the hot liquid is run off and kept until quite cool before being allowed to discharge into the nearest drain or watercourse. By arranging a small overflow pipe from this cooling tank, it can be allowed to dribble away as slowly as possible, and if properly exhausted, can be got rid of under these circumstances without causing trouble or complaint. But sometimes this method fails to be effective, and then there is no alternative to giving up the manufacture altogether, apart from transporting the spent liquor to a distance, which means considerable expense. So any plan for avoiding, or even reducing the formation of spent liquid is worthy of general attention, and therefore a process recently patented by Mr. W. Belton, the engineer of the Shrewsbury gas works, in conjunction with Messrs. Davis, of Manchester, which includes a scheme for dealing with the spent liquor in such a way as to avoid leaving a considerable bulk of residue to be run away to waste, may be noticed at some length. Mr. Belton found himself in the unfortunate position of being ordered not to allow this waste to run into the drains, and was consequently obliged to give up the manufacture of sulphate. The distance from the nearest chemical works was so great that a large proportion of the price obtainable for the ammoniacal liquor was swallowed up by freightage charges. Not being inclined to bear this loss of revenue, if it could be avoided, he investigated the matter, and the process about to be described was the result. According to a paper read by him at a recent meeting of the Midland Association of Gas Managers, the principal feature is the use of a substance known in commerce as "pure alkali," which contains 58 per cent. of carbonate of soda. Evidently the name is a trade term only, and not a fair indication of its constitution.

A solution of this material is used in place of the clean water usually added to the last scrubber or washer, and apparently it is adopted as the cheapest source for obtaining soda, as the alkaline properties of soda appear to be the key to the process. The reason for using a fixed alkali is the known fact that if equal quantities of ordinary ammoniacal liquor are boiled wiih an alkali and an alkaline earth respectively, the yield of ammonia is greater in the first case than in the second. Certain organic compounds are converted by the action of soda or potash into ammonia, which remains unacted upon or escapes in other forms if lime or magnesia is the agent used. The authors think that this can be realized in practice, and also that by using the fixed alkali for treating the foul gas before the purifiers, compounds of this nature would be retained in the liquor and not allowed to pass forward into the purifying vessels to form prussian blue, sulpho cyanides, etc., as obtains in the usual way of working. The spent liquor may be used several times in succession, being taken from the sulphate still after all the ammonia has been driven off, cooled, served with a fresh charge of "pure alkali," and supplied to the scrubbers. After a time it becomes highly charged with soda, salts, etc., and then, as the fixed ammonia has been chiefly displaced by soda, the authors claim that it can be evaporated down to get rid of the surplus water, without the nuisance that would follow any attempt to boil down ordinary spent liquor. A deposit of crystal is obtained, of which at present no use has been found, but as the quantity is very small as compared with the volume of gas treated, and would not exceed, say, a few hundredweights per week, it is easily disposed of without loss. The mother liquor may be treated in various ways. The method suggested in the paper is to mix it with quicklime and charge it into an ordinary retort. Tarry matters, ammonia, etc., pass off and are mixed with the crude gas, and the spent charge may be lixiviated to recover soda.

This process was devised as a means of avoiding the accumulation of spent liquor, but Mr. Belton claims that it has succeeded beyond anticipation, and proved capable of yielding a larger proportion of sulphate per ton of coal than is obtained by the ordinary process. If this claim can be supported, it is a step in advance that might well be adopted without reference to any difficulty with regard to spent liquor. The cyanogen matters at present go to waste so far as gas companies are concerned, and any gas manager would be open to increase his sales of sulphate. The energetic properties of the freed alkalies as purifying agents for gas have always proved attractive to inventors, but I do not know that they have ever been tried on a really respectable working scale. Hitherto their cost has been a drawback, but this has been largely reduced of late years, so Mr. Belton's process stands on a better footing than its predecessors. It also remains to be seen how far the use of strong alkaline solutions will affect the question of wear and tear, and also whether they have any prejudicial effect on the illuminating power of the gas.

Most of us have heard of the Scottish lady who gave the Russian soldiers a taste of the broom handle in the course of the Crimean war, and a similar spirit seems to have been exhibited in a certain small town in Scotland a few days since. The gas works are the property of the corporation, and one of the Commissioners appears to have been anxious to get some information in a roundabout hole and corner sort of way. He was found on the works by the Manager after 10 o'clock at night; and the next day he visited the works again whilst the Manager was away attending to some main laying. But he had not reckoned for the Manager's "good lady," who promptly appeared upon the scene, seized him by the back of the neck, and escorted him to the outside of the premises with more force than elegance. Such an affront to the dignity of a Gas Commissioner has been the subject of elaborate discussion at meetings of the Committee. The Gas Manager, on being called upon to explain, pleaded some justification for the assault, but the aggrieved

Commissioner denied this, and somebody pointed out that no apology was offered. The dignity of the Commissioners appears to have been the chief point in view, and they called upon their official to make a handsome apology and to undertake that "it shall not occur again." How far a man is responsible in these days for his wife's actions, or capable of entering into an undertaking on her behalf, is a somewhat complicated point. It is also rather invidious to be asked to publicly confess that the wife is in the wrong. Perhaps the lady will cut the knot by tendering the apology in person, or otherwise answering for her actions, as she appears well able to do, and meanwhile the Commissioners, if they want to visit the gas works, will take care to select an hour, not only when the Manager is at the main laying, but also when the lady is shopping, visiting, or otherwise occupied at a distance.

This amusing episode comes as a corollary to my remarks last month. Of course, it is impossible for a stranger, unacquainted with the parties concerned, to express a fair opinion as to who is in the wrong in this matter, or to what extent both may be so. It is certainly somewhat derogatory to the dignity of a Commissioner to be ejected from what he evidently regarded as his own property in the manner above indicated, possibly in the presence of grinning workmen, whose love for the joke would be greater than their respect for the Councillor. But there are two sides to this, as to most other questions. The slight afforded to their own dignity appears to have rendered the Commissioners indifferent to all other considerations, or they might have remembered that even gas managers are entitled to a proper measure of respect and confidence. It may safely be conjectured that if the lady chose to practice the functions of a "chucker-out" as a pastime, she would not select a "Commissioner" to begin on. Going to the works behind the back of the manager implies some remissness on this point, and if it had been properly borne in mind, possibly the worthy Councillor would have been allowed to make his exit from the gas works yard in the orthodox way, and in a manner more becoming to the dignity of a Commissioner. The reminder was forcible and to the point, but perhaps not altogether unnecessary.

Ever since the electric light has been introduced into ordinary commercial affairs, it has been the custom of some of those interested in its sale to depend not only upon the advertisement of its own merits as a means of introducing it, but upon statements of a more or less exaggerated character respecting the products of combustion from ordinary coal gas. The actual result of burning gas in ordinary rooms is matter that can be easily demonstrated. The proportion of carbonic acid and moisture in the air, and also of carbonic oxide or other products of incomplete combustion, can be easily and accurately determined by any expert analyst. So there is no excuse for those who, while pretending to some knowledge of science or of engineering, circulate inaccurate or distorted reports as to the effects of the products of combustion of coal gas as regards health, and its relation to ventilation. And yet scarcely a week passes without the circulation of some sensational report intended to frighten people into cutting off the gas supply from their houses. As a matter of fact, proper ventilation for dwelling rooms was found to be necessary long before gas was thought of. The use of gas or otherwise has a very remote bearing on the point. According to the latest researches of physiologists and those who have investigated the air supply of hospitals, schools or barracks a certain supply of fresh air per head is necessary to health. And if anything like the quantity indicated is maintained, all products of combustion, whether for gas or anything else, are removed from the apartment without coming into contact with the occupants, or at any rate so far diluted as to render the question of no importance. There is reason to believe that certain poisonous matters are emanated from the human body, and that the object of ventilation is not only to maintain a proper proportion of oxygen in the air, as is generally supposed, but to dilute these organic poisons to a sufficient degree to render them innocuous.

With these facts in mind, it is evident that all the talk about gas flames destroying the oxygen of the air, or loading it with poisonous products of incomplete combustion, is entirely fallacious except as regards rooms where the ventilation is already insufficient. All this has been shown over and over again, and yet the same old lie is continually reappearing. Only within the last few days a determined set has been made at the incandescent gas light by the circulation of a report that it gave off large quantities of carbonic oxide. In this case, however, the result is very satisfactory, for it has furnished a splendid advertisement for the Incandescent Gas Light Company by affording them an opportunity for publishing an indisputable mass of evidence, scientific and practical, to the effect that gas light, and the incandescent light in particular, does not vitiate and has no prejudicial effect upon the atmosphere in rooms that are properly ventilated.

Wind Pressure.

An interesting paper on wind pressure was lately read by Professor W. C. Kernot before the Adelaide meeting of the Australasian Association for the Advancement of Science. The amount to be allowed for in designing a structure has long been recognized as very disputable. The pressure is modified enormously by different conditions. In the case of a roof, the vertical wall of the building may, by deflecting the wind current, greatly reduce the wind load, and similarly the leading edge of a plane inclined to the wind experiences a greater pressure than the leeward one. The old formulas connecting wind pressures and velocities are known to be most misleading, and, further, as has been shown by repeated experiments, the maximum mean pressure on a surface of many square feet in area is only about two-thirds the maximum pressure recorded on a single foot of it. The Board of Trade require in bridges an allowance for a pressure of 56 pounds per square foot, though a pressure of about 35 pounds per square foot would overturn nearly every carriage running on our railways. Professor Kernot's experiments as described in his paper have been directed to two points in particular, viz., the relation between the pressure and velocity, and the determination of the modulus of different forms. The former experiments were not very satisfactory, as the results were somewhat discordant. The modulus of a form may be defined as the ratio between the area of normal cross section of a solid body, and that of a flat plate which, exposed to the same wind, has the same total pressure on it. The wind was obtained by means of a special form of fan, the arrangements being such that a fairly uniform velocity was obtained at the outlet. The models to be tested were placed in the center of the blast, and the pressure on them recorded directly by a delicate and carefully calibrated spring balance. Thus the total pressure on rectangular blocks was practically the same whether they were placed with one face normal to the wind or diagonally. This total pressure was found to be .9 of that on a thin flat plate equal in area to one face in the case of a cube, and from .7 to .9 in the case of other rectangulars, the higher figure being obtained for blocks more than three times as high as the width of the base. A rectangular pyramid like a church tower showed a modulus of .8 when placed with one face normal to the wind. When placed diagonally, the pressure was increased 25 per cent. Cylinders gave a modulus of .52, and a cone, one of .5. An octagonal prism experienced 10 per cent. greater pressure than its circumscribing cylinder, whilst a sphere had a modulus of .36. Hemispherical cups, such as are used in Robinson's anemometer, had a modulus of .36 when the convexity faced the wind, and one of 1.15 when the concavity did so. With model roofs a number of interesting experiments were made, and the effect of the vertical walls of a building in reducing the pressure was very marked.

With a roof of 60° pitch the pressure was reduced 40 per cent., and with one of 45° pitch 80 per cent., whilst with one of 30 per cent. there was no observable pressure on the roof. When the wall is extended in the form of a parapet, the sheltering effect was much enhanced, and with a low pitch a negative pressure was then actually observed. The lifting effect was tested by a model house having two ends and one side closed, the other being open and exposed to the wind. The lifting pressure on the roof was found equal to that on an equal normal plane. Model plate girder bridges were next tested, with the result that when the two girders were separated by distances equal to their height, the leeward one was fully sheltered, but when the distance was doubled the pressure on the leeward one experienced a pressure of one-fifth that on the windward one. The pressure on latticework was tested by means of two cards, each 6 in. by 8 in. One of these cards had 16 rectangular openings cut into it, removing 43 per cent. of its area. The pressure on it was found to be 83 per cent. of that on the solid card. Placing the grating in front of the solid card, the pressure on the latter was reduced, as shown by the following figures:

Card.....	6 in. by 8 in.	.37 lb.	pressure.
Card grating.....	1½ in. in front	.23 "	"
" "	3 "	.17 "	"
" "	4½ "	.12 "	"
" "	6 "	.11 "	"
" "	7½ "	.16 "	"
" "	9 "	.20 "	"

One curious point was noted, viz., that when a card 3 in. square was placed in front of a card 9 in. in diameter, the pressure on the former was reduced. The large card apparently caused a deflection of the stream lines which was banked up in front of it, diverting the current round the small card, the pressure on which was therefore reduced. When tested alone, the small card showed a pressure on it of .15 lb.

With the disc 12 inch behind it, this was reduced to .14 lb., at 9 in. to .11 lb., at 6 in. to .09 lb., at 3 in. to .07 lb., and at 1 in. to .03 lb., or only one-fifth of what it endured if the disc were removed. The well-known phenomena of attraction between a large disc and a small one placed behind it was also observed. Another important point noted was that if the wind was prevented from escaping on one side of a cylinder or cone, the pressure was increased about 20 per cent. The effect was not noted with rectangular blocks.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following letter from Mr. J. P. Gill, written to the JOURNAL, under date of November 26th, explains itself:

To the Editor AMERICAN GAS LIGHT JOURNAL: As no one should think himself infallible, forgetting that pride goeth before destruction, which effect is sure to follow sooner or later, depending, of course, upon the peculiar circumstances of the case involved, a prudent person should rather court criticism, if it be judicious and sincere, than object to it; for this, like experimentation in mechanics and natural philosophy, is a correct method of attaining truth and the knowledge of useful facts. Thanks are therefore due to Mr. Newbigging for his criticism in the JOURNAL, of November 19th, of my communication of August 13th. Perhaps I did not express myself with adequate distinctness in that article, but I certainly intended to make a distinction between illuminating power and illuminating effect, which appeared to me to be practically equivalent to intensity and quantity of light. My surprise, consequently, was quite natural on finding it stated that I assumed these to be synonymous terms, and argued from that standpoint, supposing that I took no account of the other factors, beside that of carbon, upon which lighting effect depends, with the suggestion that I should have noticed that he (Mr. N.) had stated that illumination was more a question of method of burning than of actual quality. By reference to my article it will be perceived that I said: "A 20-candle gas consumed in a proper burner, which will heat to whiteness the particles of carbon and permit them to be converted into carbonic acid gas before they leave the flame," etc. Also, when speaking of the increase of candle power of the gas furnished the mills in a certain city, "It need only be added that proper care was taken to secure proper burners and attention was given to the mode of combustion. This, of course, in any case, is important." In illustration of the distinction between power and effect, I showed the difference in lighting effect in stores which were sometimes lighted with gas and sometimes with kerosene, the former having more quantity and diffusiveness, the latter more intensity, but with a more localized light. The same distinction was emphasized by the comparison of the light of the usual kerosene lamp and that of a gas light, when located near each other. In view of these quotations from my former article, and in any event, it is impossible to perceive the logic of the position taken by Mr. Newbigging that because he thinks a 16-candle gas is better than a 22-candle gas, and I happen with others to think the reverse, that there is any begging of the question. Here is simply a question of fact, and of opinion based on fact, and as I assert nothing without reason, and am in goodly company, there can be no begging in the case. Indeed, might not the charge be justly retorted? The claim that "illumination is more a question of burning than of actual quality," can hardly hold good. It is almost too well known to require repeating that the light given by gas in a state of combustion depends upon and proceeds from the incandescent particles of carbon. These being the source of the light, and the groundwork of the process, the method of burning, however necessary and important, is secondary, being but the means of utilizing the "actual quality," or the real material source of the illumination. Cooking, which is the act of man, is not of the primary importance that the food is which nature furnishes. As a practical man in this discussion, writing for practical effects, it was the intention to avoid too abstract methods and nice and unusual scientific experiments, and to employ such facts as are readily observed and easily understood and studied. Illuminating power and illuminating effect depend practically upon four things—the burner, the pressure, the quantity of carbon in the gas and the heat of the flame; or, to amplify somewhat, (1st) The quantity of carbon. The more molecules of carbon heated to intense whiteness the greater the number of radiating points and the greater the light. (2d) The flame should be on the verge of smoking in order to utilize the greatest number of the carbon molecules. (3d) A low pressure, that there may be a slow combustion. (4th) The heat of the flame; to produce the greatest possible degree of whiteness, having intense heat with slow combustion. (5th) The thickness of the flame; if too thick, the light is not properly radiated; if too thin, it is defective and more or less pale. (6th) A sufficient supply of oxygen, properly applied, to convert all the carbon into carbonic acid gas as it leaves the flame, and also to prevent loss by unconsumed carbon; restricting the supply, however in order not to consume the carbon before it becomes intensely white hot, and allowing time for the proper radiation of the light. A flame when too thick, and when properly heated, may, under the right conditions, give a more intense light, but will be deficient in diffusiveness or illuminating effect, as compared with the quantity of carbon consumed; if too thin, its characteristic will be to give out more heat than light, similar to a Bunsen burner. This last effect may be produced by too great a pressure or by defective burners. With reference to the temperatures, the less nitrogen that is used, of course, the better. Nitrogen being inert abstracts heat and reduces the temperature of the flame, impairing its efficiency or increasing the loss. Of the three heating gases, H, H_4C and CO, the H_4C is the most effective per volume. One pound of H, above 212°, produces 53,330 heat units, one of H_4 C, 22,065 heat units, and one of C O, 4,400 heat units. Now, 178.9 cubic feet of H and 22.35 cubic feet of H_4 C, and 12.77 cubic feet of C O, each weight one pound. Hence 1 cubic foot of H gives 298 heat units, 1 cubic foot of H_4 C, 987 units, and 1 cubic foot of C O, 345 heat units. By heating the gases before combustion there will also be a gain. When burners are so constructed as to cover the 6 points specified above we shall then have the greatest quantity of light that illuminating gas is capable of giving, and it will be an economical light. The value of the Welsbach lamp consists in its capability of being made highly incandescent without combustion. A burner constructed to give lighting effects as indicated above, would probably compete with the Welsbach lamps. I have endeavored to show, while writing in my own behalf and vindication, that perhaps Mr. Newbigging and myself do not differ so much as at first sight might appear. It has been asserted by those considered competent to judge that three-fourths of the differences of opinion among men arise from the fact that words do not convey the same ideas or the same images to different minds.

MR. JOHN S. CONNELLY, who will be pleasantly remembered by the fraternity from his former connection with the Connelly Iron Sponge and Governor Company and with the Connelly Motor Company as well, has purchased a half interest in the Titusville (Pa.) Gas Company, and took charge of the property on November first. The local electric concern seems to have good cause for regretting Mr. Connelly's presence in Titusville, for he is taking on a large number of former patrons of incandescent electric lighting, the Welsbach incandescent burner being the means of inducing them to make the change.

MANAGER BENNETT, of the Freehold, N. J., Gas Company, has again made his shareholders happy, in that they have received checks for the November dividend, which amounted to 3 per cent. on the capital stock.

MR. J. J. MCKEEVER, General Manager of the Houston (Texas) Gas Light Company, writing to us under date of the 22d inst., says: "The following clipping is from the Houston *Post* of yesterday: 'Johnson v. Houston Gas Light Company; damages. Plaintiff alleges that, on the 26th of September last, while engaged in making connection with a main of the Houston Gas Light Company, in whose employ he was, the gas escaped from a hole he had cause to make in the main, that he was overpowered by the gas and taken from the trench in which he was working in an insensible condition; that on account of this he has been subject to convulsions and pains in the side and back and roaring in the head; that he is probably disabled for life; that the defendant Company is liable, by reason of negligence, in not cutting off the supply of gas, wherefore plaintiff prays for damages in the sum of $10,000, and all costs of suit.'"

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed the steel roof trusses for the addition which the Baldwin Locomotive Works, of Philadelphia, Pa., is about to make to its wheel shops.

AT a meeting of the Galveston (Texas) Council, held something over a fortnight ago, the following ordinance was recommended for passage:

"Be it ordained by the City Council of Galveston:

"Section 1.—That the grant or license to Alfred F. James and others having passed to the Galveston Gas Company, and the term of said license having expired, that the same be and is hereby in all its terms renewed to the Galveston Gas Company for the period of 25 years from this date.

"Sec. 2.—That this grant or license is made subject to the charter and ordinances of the city of Galveston as the same now are or may heretofore be.

"Sec. 3.—That the Galveston Gas Company shall signify in writing its acceptance of this license."

GENERAL JAMES JOURDAN, President of the Fulton-Municipal Gas Company, of Brooklyn, N. Y., has been appointed General Manager of the New York and East River Gas Company.

THE proprietors of the Oakland (Cal.) Gas, Light and Heat Company have received the regular monthly dividend of 30 cents per share for November.

The Findlay (Ohio) *Republican* says that Mr. Fred. P. Whiteley, of the law firm of Pendleton & Whiteley, claims that he has succeeded in enlisting Detroit capital for the purpose of establishing an artificial gas plant in Findlay. The projectors say that they will supply a gas of high candle power for illuminating purposes, the price to be charged therefor to be $1.25 per 1,000 cubic feet. Gas supplied for heating and power purposes to be billed at 80 cents per 1,000. We believe that an application has been made to the Council for a franchise.

MR. RICHARD HALNAN, JR., formerly in the employ of the Oakland (Cal.) Gas, Light and Heat Company, has been appointed inspector of electric light meters to the electric lighting enterprise which is being managed by the municipal authorities of Alameda, Cal.

THE mortgage sale of the plant and franchises of the Chattanooga (Tenn.) Electric Light Company, which was set for November 22d, was postponed to December 20th.

AT a meeting of the Rahway (N. J.) Gas Company, the following officers were chosen: President, William Mershon; Treasurer, H. Simmons; Secretary, R. Horton.

JUDGE JOSEPH H. GASKILL, of Mount Holly, N. J., has been appointed receiver of the Neptune Electric Company, which concern supplies electric lighting currents in Asbury Park, N. J., and in the adjoining towns. It is said that over $100,000 has been lost in this enterprise.

AT a called meeting of the Superior Water, Light and Power Company, of West Superior, Wis., ex-Governor W. R. Merriam, of Minnesota, was elected President, to fill the vacancy occasioned by the death of Mr. A. H. Wilder.

PETER WARD, who was connected with the Citizens Gas Company, of Willimantic, Conn., recently resigned therefrom to take charge of the gas plant operated in New Haven, Conn., by the New York, New Haven and Hartford Railroad Company, for the supply of compressed gas to its passenger coaches.

LAST week we intimated there was a project on foot for the establishment of an opposition gas works for the town of Medford, Mass., and now we can state that the Company has been organized, under the name of the Citizens Gas Company, by Messrs. F. D. Allen, H. E. Turner, C. J. Lee, Warren Sawyer, J. A. Pierce, W. H. Perkins, W. S. Cushing, W. E. Neal, Nathan Warren and Jas. B. Niver. The Directors named were: F. D. Allen, H. E. Turner, Chas. J. Lee, J. A. Pierce and Walter S. Cushing.

THE Mount Vernon (Ills.) Gas Company has been incorporated by Messrs. C. W. Pavey, S. H. Watson and Adam Culli. It is capitalized in $100,000. This place is a post village of Jefferson county, Ills., and is located on the St. Louis and Southeastern Railroad, at a point 77 miles east-southeast of St. Louis, Mo., and about 20 miles southeast of Centralia, Ills. It has a number of mills, and has a population of about 4,200.

AT the annual meeting of the Gilroy (Cal.) Gas Company, the officers chosen were: Directors, H. R. Chesbro, A. Robinson, L. A. Whitehurst and S. T. Moore; President, L. A. Whitehurst; Secretary and Treasurer, C. E. Whitehurst. The Company's business is improving rapidly under the fostering care of Mr. George Keaton, who operates the plant on a leasehold which does not terminate until April, 1897.

MR. JAS. L. SCOTT, owing to proceedings instituted against the Saratoga Springs (N. Y.) Gas and Electric Company by the New York Security and Trust Company, has been appointed referee to conduct the sale at auction of the plant and franchises of the Company, January 3d, 1895.

THE people of Moorestown, N. J., have asked the proprietors of the local electric lighting company to establish a gas plant, failing which action it is asserted that a gas works will he built by other parties. Moorestown is about 9 milesfrom Camden, and has a population of less than 3,000.

MR. COLLINS, of the Third Ward, of Boston, Mass., recently introduced the following order in the City Council: "*Ordered*, That the Committee on Ordinances be requested to submit to the City Council the draft of an ordinance providing for the appointment of an Inspector of Gas, whose duty it shall be to inspect all work done in the way of introducing gas into buildings in the city of Boston, and see that such work is done in a proper manner and with due regard to the safety of such buildings from fire." The matter was referred to the Committee on Ordinances.

THE authorities of Huntington, L. I., have entered into a contract with the Standard Gas and Electric Light Company of that place whereby the latter will furnish 100 gas lamps on public lighting account, to be lighted at dusk and extinguished at midnight each night in the year, payment to be made therefor at the rate of $18 per lamp per year. It is likely the authorities will agree to maintain a certain number of lamps in the business portion of the town on an every night and all night basis, the Company agreeing to perform such service at the rate of $25 per lamp per annum.

IT is possible that the interests of the Lancaster Gas Light and Fuel Company, the Edison Electric Illuminating Company and the Citizens Electric Company, all of Lancaster, Pa., will shortly be combined.

THERE is some talk of appealing to the Board of Gas and Electric Light Commissioners for a revision of the Brockton (Mass.) gas rate. The average price received by the Company for all gas sold by it during 1893 was $1.97 per 1,000 cubic feet.

THE Detroit *Journal* says that the Detroit Gas Company has made another issue of bonds. They are called First Series Income Bonds, and there are 470 of them—300 of $100 each, and 170 of $1,000 each. A trust deed or mortgage to secure these bonds has been filed with the City Clerk, and it is signed by Eugene T. Lynch, President, and M. W. O'Brien, Secretary of the Detroit Gas Company. It is in favor of the New York Guaranty and Indemnity Company. It is stipulated that before the interest on the issue is paid, taxes, repairs, operating expenses and the sinking fund shall be provided for, and also the interest on previous issues of bonds, as follows: $500,000, April, 1878, given by the old Mutual Gas Company, and held by Charles F. Dean, Trustee; $500,000, December 1, 1892, secured by a mortgage executed by W. C. McMillan to Thompson Dean; $1,000,000, secured by a mortgage held by Alexander Lewis, Jerome Croul and C. B. Lothrop, as Trustees; $4,500,000 consolidated first mortgage bonds, 5 per cent., issued February, 1893. The Detroit Gas Company is therefore paying interest on $6,700,000 worth of bonds.

THE Pittsburg (Pa.) *Times* says that a suit arising from an alleged breach of contract between Joseph Askins and the Manufacturers' Gas Company, of Greensburg, Pa., has been opened before Judge Acheson, in which Askins seeks to recover $14,300, a part of his claim, and $20,000 damages. A motion was made for a non-suit, and pending the argument an adjournment was taken, Judge Acheson desiring time to consider the case. Askins was the contractor for the defendant Company, having constructed for it a plant which subsequently was burned. The Company rebuilt it and Askins was to put in machinery equal to the make of a named quantity of gas each 24 hours, and in the end the matter of determining whether the contract specifications were fulfilled was left in the hands of a board of arbitrators. The arbitrators found that an additional set of purifiars was required, which Askins consented to provide, in so far as the boxes proper were concerned, but he would not agree to put in the foundations for same. The Company claimed he was also bound to furnish the latter; hence the suit.

ANOTHER explosion is reported to have taken place in the generating room of the West Manayunk (Pa.) gas works, which was of sufficient violence to do considerable damage to two adjoining factories—the Standard Plush Mills and the worsted mills of the Messrs. John & Jas. Dobson. The loss is put at $9,000, and there is little doubt that the disaster is traceable to the gross neglect of an employee of the gas works.

THE property and franchises of the Regina Electric Light and Power Company, of Manitoba, are to be sold at foreclosure sale on the 19th inst.

THE supply of natural gas in the Findlay (Ohio) district is fast giving out, and the owners of the pipe line are fearful that the end is close at hand. The Creighton well, which a year ago showed a rock pressure of 180 pounds, is now said to be down to 19 pounds, and so it is in proportion all over the field.

The Market for Gas Securities.

The market for city gas shares was dull and strong during the week, Consolidated being quoted to-day at 124¾ to 125. Equitable is in demand at 178, Mutual is inquired for at 153, and both preferred and common of the Standard issues are higher. New York and East River common is quoted at 22 to 24. It is understood that the last named concern has its canvassers out offering time contracts to consumers on the basis of a charge of 90 cents per 1,000, and it is more than passing strange that Gen. Jourdan, on his appointment to manage the East River Company, should cut the price to 90 cents in New York, whereas he has just raised the rate over in Brooklyn from 90 cents to $1.25. The ground for the latter action is that gas at 90 cents per 1,000 does not pay the manufacturers. The Fulton-Municipal, Metropolitan, Nassau, and Williamsburgh Companies' shares are all bid for at 200, and no stock is offering. No doubt these four, and the old Brooklyn as well, have made a satisfactory agreement respecting their future course. Chicago is lower, at 71¾ to 72, and Bay State is irregular, and to our mind inclined to weakness.

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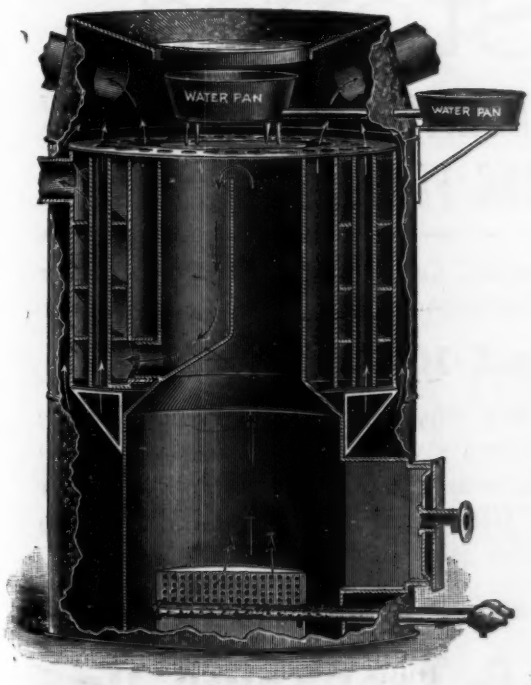

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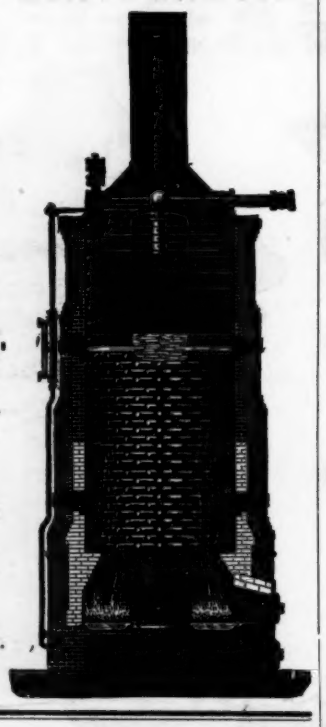

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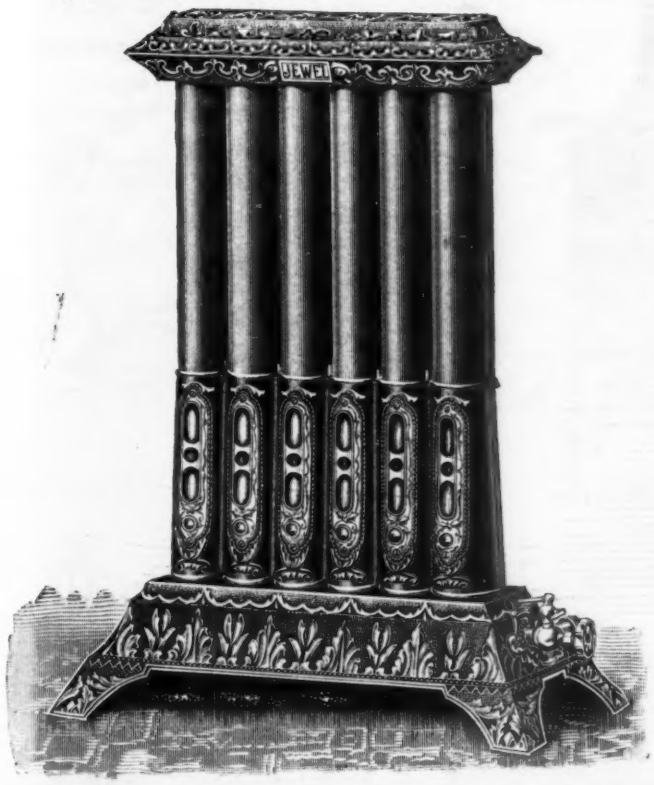

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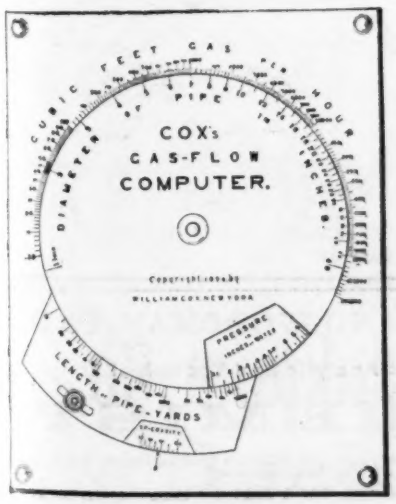

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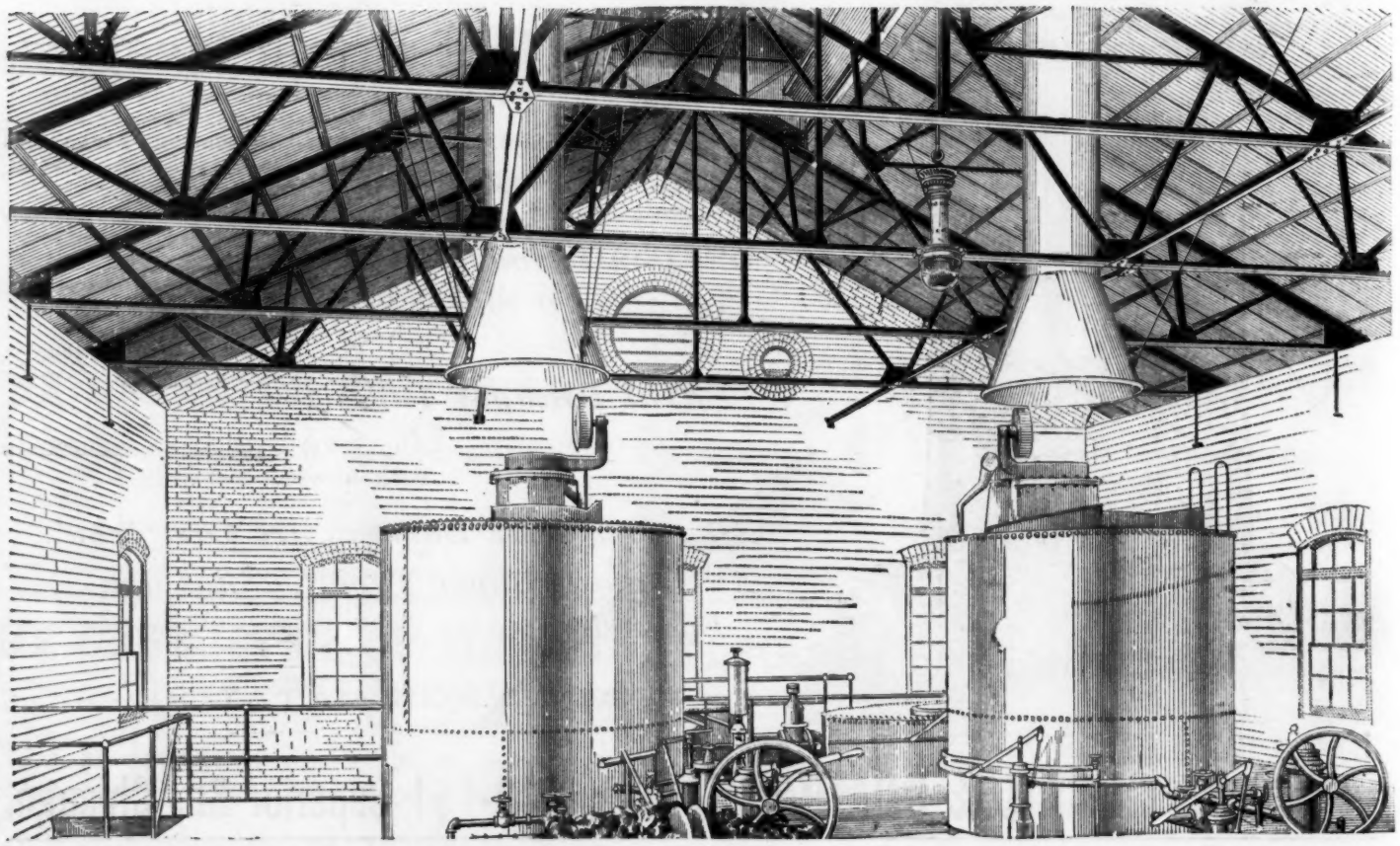

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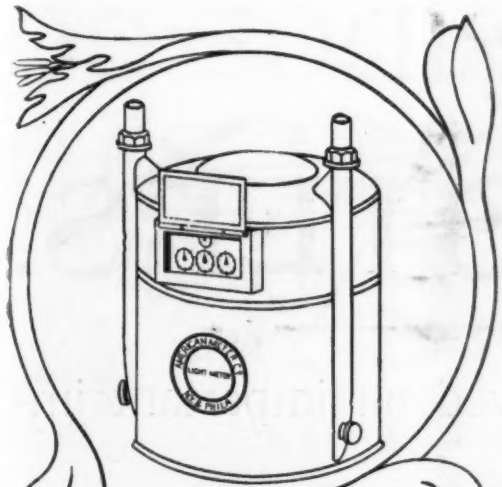

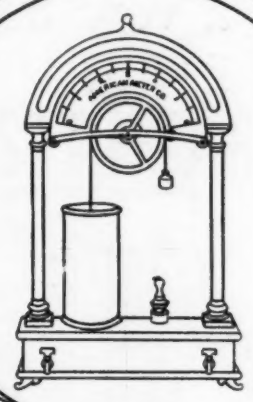

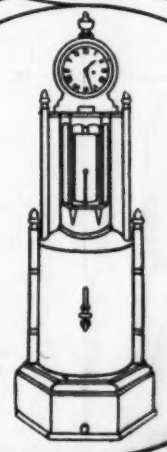

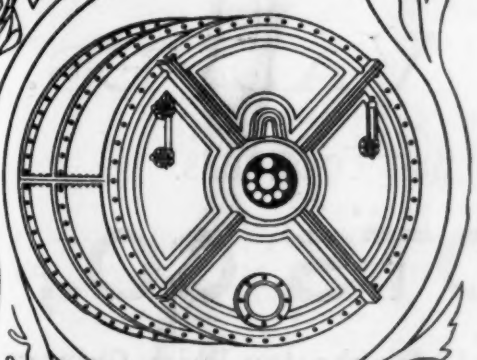

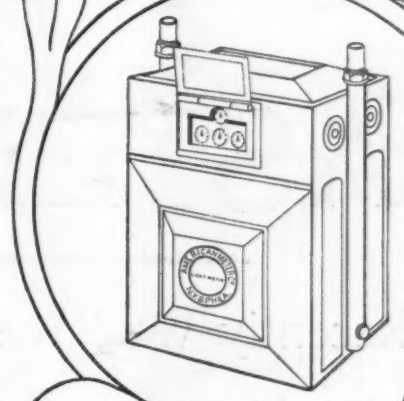

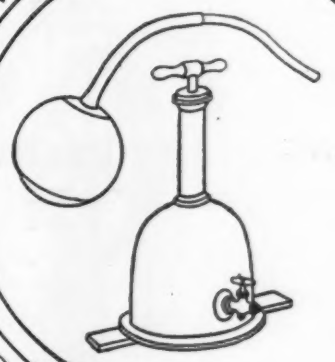

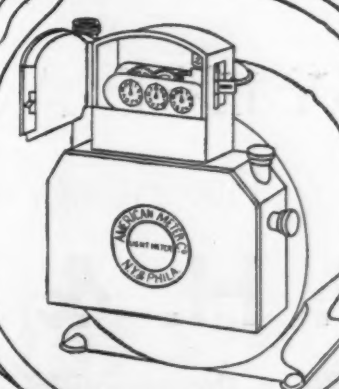

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PUBLIC LIGHTING TABLE.

DECEMBER, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	5.10 PM	6.00 AM	4.20	6.10
Sun.	2	8.10	6.10	4.20	6.10
Mon.	3	9.20	6.10	4.20	6.15
Tue.	4	10.20	6.10	4.20	6.15
Wed.	5	11.20 FQ	6.10	4.20	6.15
Thu.	6	12.20 AM	6.10	4.20	6.15
Fri.	7	1.20	6.10	4.20	6.15
Sat.	8	2.30	6.10	4.20	6.15
Sun.	9	3.50	6.10	4.20	6.15
Mon.	10	5.00	6.10	4.20	6.20
Tue.	11	No L.	No L.	4.20	6.20
Wed.	12	No L. FM	No L.	4.20	6.20
Thu.	13	No L.	No L.	4.20	6.20
Fri.	14	5.10 PM	7.30 PM	4.20	6.20
Sat.	15	5.10	8.50	4.20	6.20
Sun.	16	5.10	10.10	4.20	6.20
Mon.	17	5.10	11.20	4.20	6.20
Tue.	18	5.10	12.40 AM	4.20	6.20
Wed.	19	5.10 LQ	1.50	4.20	6.20
Thu.	20	5.10	2.50	4.20	6.20
Fri.	21	5.10	4.00	4.20	6.20
Sat.	22	5.10	5.10	4.20	6.20
Sun.	23	5.10	6.20	4.20	6.20
Mon.	24	5.10	6.20	4.20	6.25
Tue.	25	5.10	6.20	4.20	6.25
Wed.	26	5.10 NM	6.20	4.20	6.25
Thu.	27	5.10	6.20	4.20	6.25
Fri.	28	5.10	6.20	4.20	6.25
Sat.	29	5.10	6.20	4.20	6.25
Sun.	30	5.10	6.20	4.20	6.25
Mon.	31	8.10	6.20	4.20	6.25

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45

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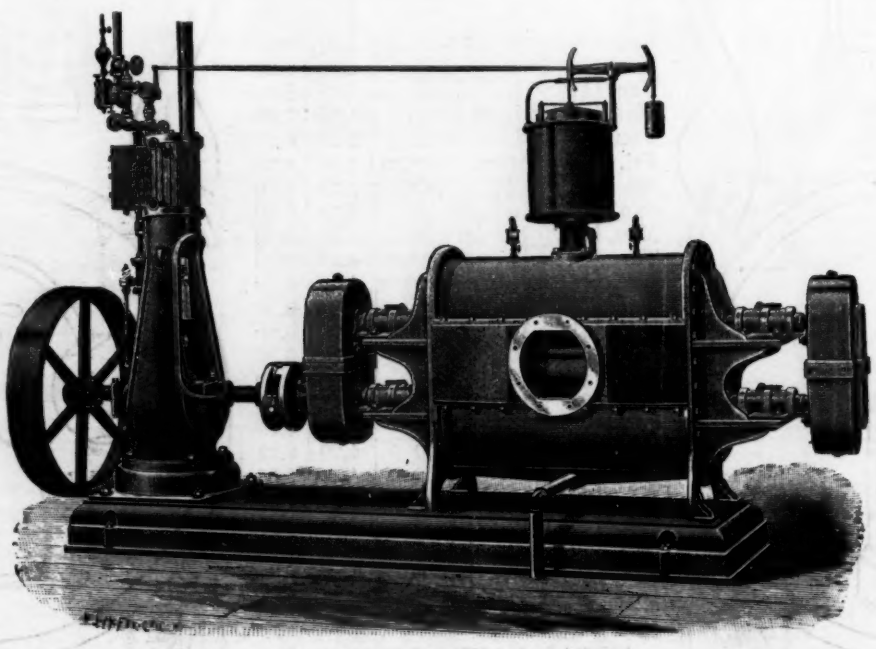

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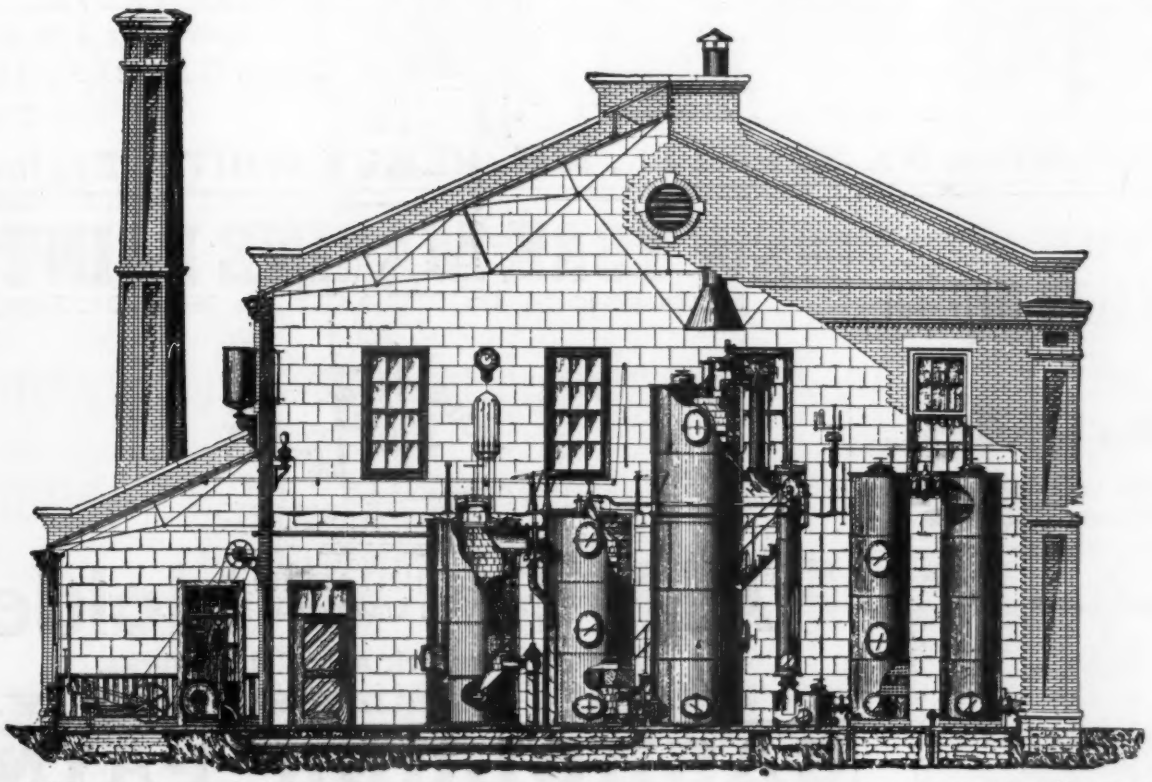

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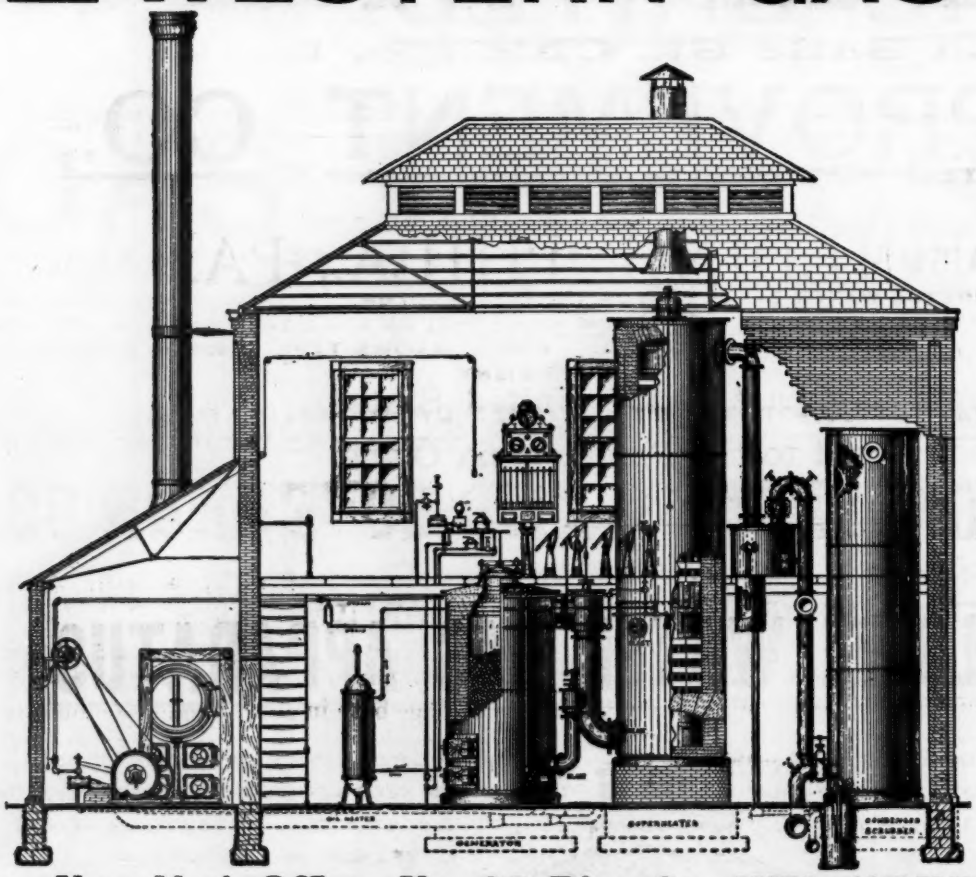

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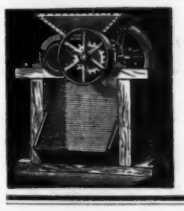

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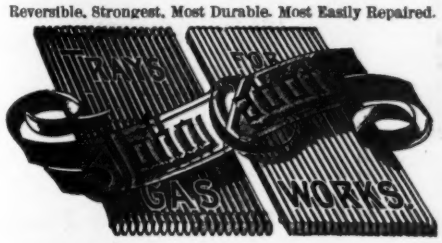

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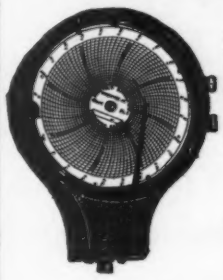

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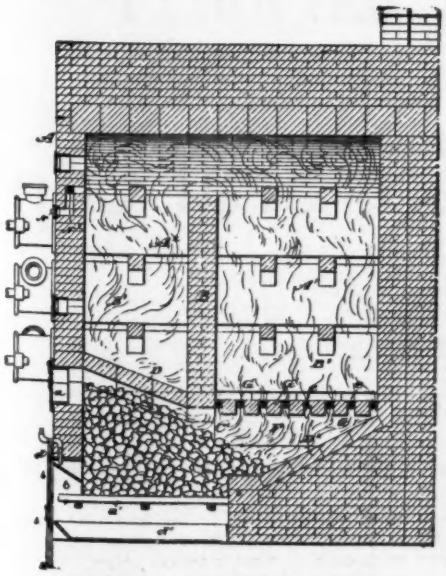

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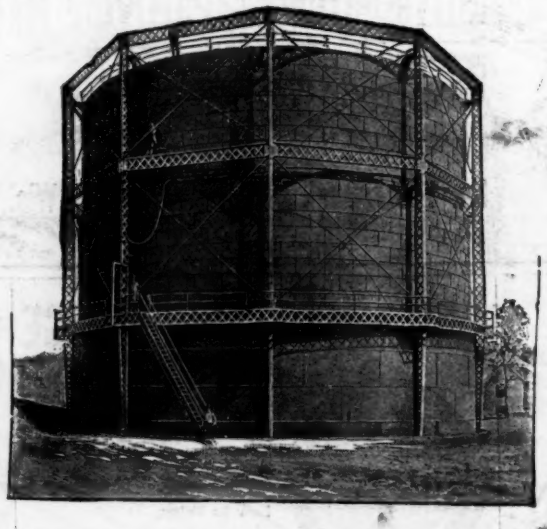

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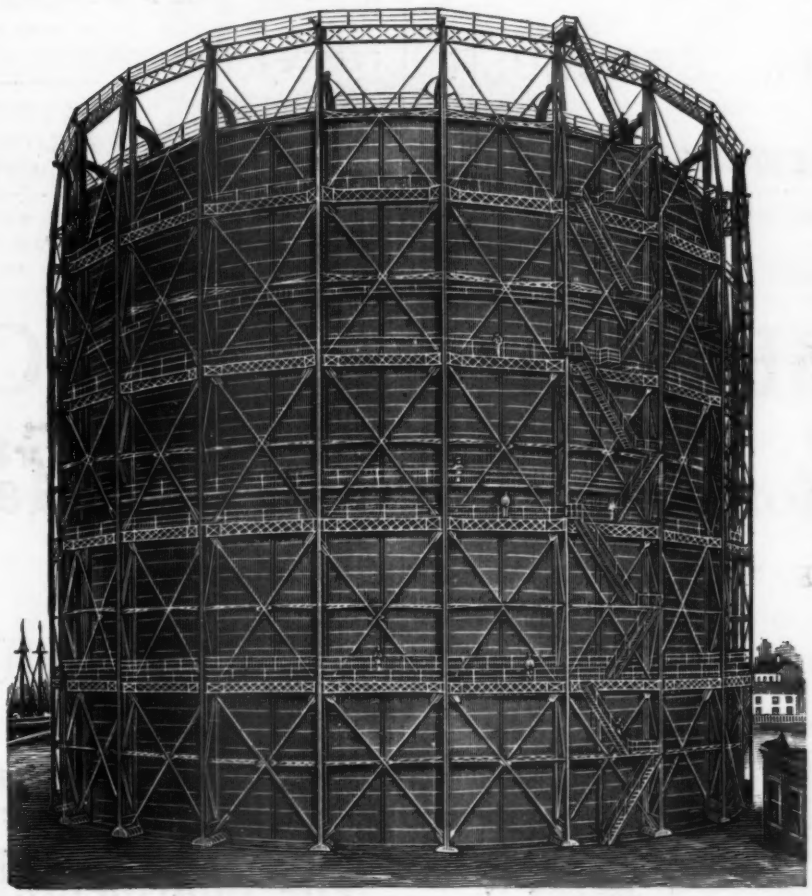

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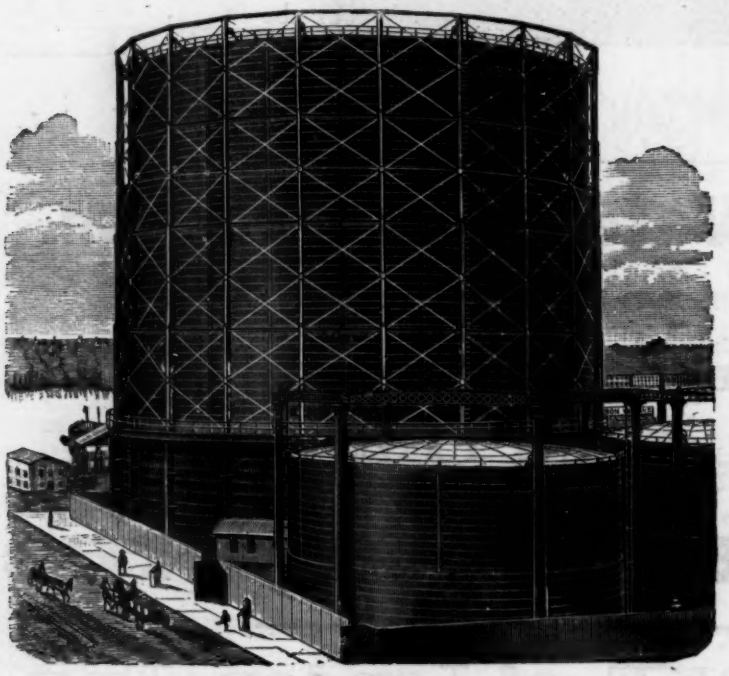

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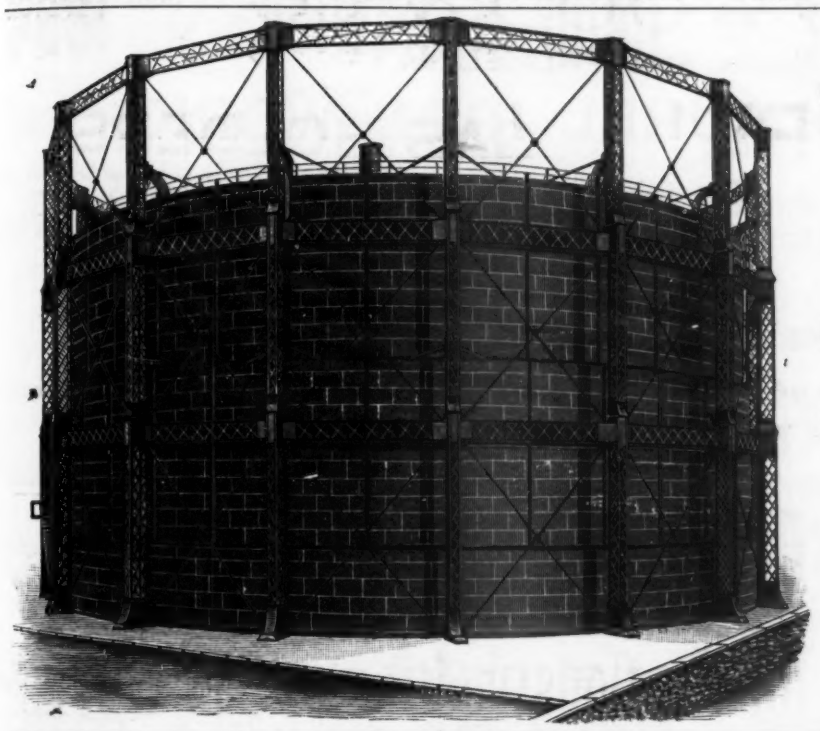

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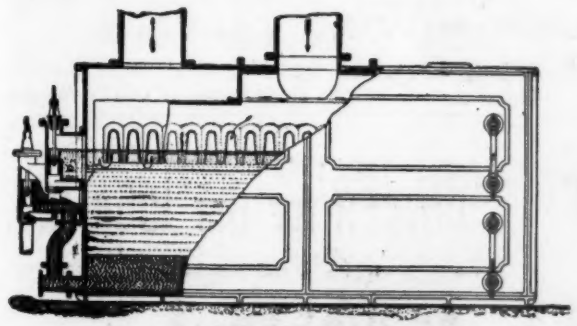

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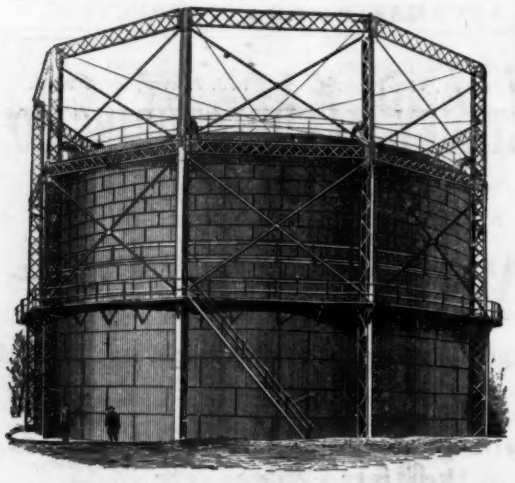

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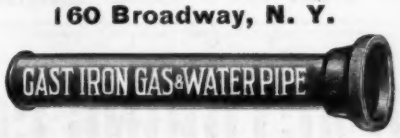

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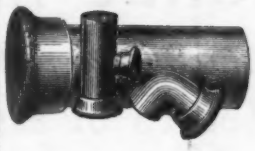

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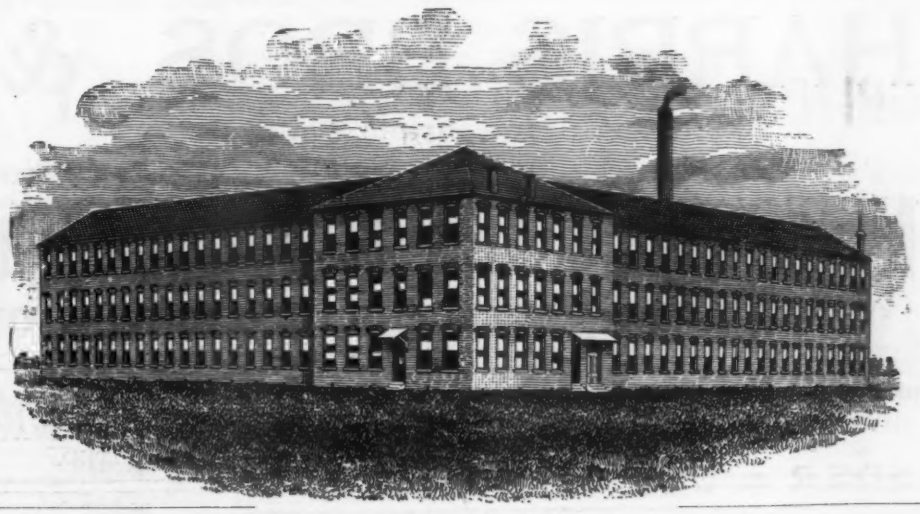

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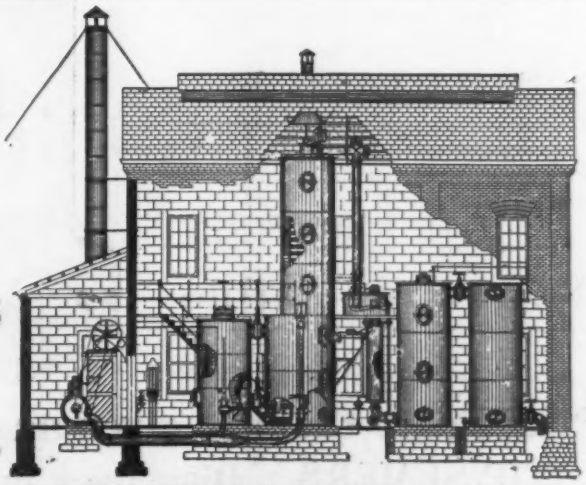

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